REGION 5 RAC2

REMEDIAL ACTION CONTRACT FOR

Remedial, Enforcement Oversight, and
Non-Time Critical Removal Activities at Sites of Release
or Threatened Release of Hazardous Substances in Region 5

REMEDIAL INVESTIGATION REPORT
OMC WAUKEGAN HARBOR SITE
Waukegan, Illinois

Remedial Investigation/Feasibility Study

WA No. 042-RICO-0528/Contract No. EP-S5-06-01

April 2008

PREPARED FOR

U.S. Environmental Protection Agency

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Executive Summary

This Remedial Investigation (RI) report integrates the results from the recent U.S. Environmental Protection Agency (USEPA) investigations completed at the Waukegan Harbor operable unit (OU) of the Outboard Marine Corporation (OMC) Superfund site in Waukegan, Illinois. The purpose of this RI report is to summarize the data collected during the investigations, document the physical characteristics and the nature and extent of polychlorinated-biphenyl (PCB) concentrations in the harbor sediment, and present conclusions drawn from these characterizations regarding risk to the public health and the environment. The results of the RI will be used to formulate remedial action objectives and to provide the foundation for developing a feasibility study in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Contingency Plan (NCP).

Site Description

Waukegan Harbor is located on the western shore of Lake Michigan, about 40 miles north of Chicago, Illinois in the City of Waukegan (City), Illinois, and 10 miles south of the Illinois/Wisconsin border. Based on current uses and historical activities, the harbor has been divided into the following harbor segments:

- Approach Channel
- Outer Harbor
- Entrance Channel
- Inner Harbor
- Marina
- Inner Harbor Extension
- Slip 1
- North Harbor (includes Slip 4)

The federal navigational channel of Waukegan Harbor includes the Approach Channel, Outer Harbor, Entrance Channel, the Inner Harbor, and the Inner Harbor Extension. The Approach Channel is not included as part of this RI.

Background

Waukegan Harbor is part of the OMC Superfund site that includes four OUs: the Waukegan Harbor site (OU 1), the Waukegan Manufactured Gas and Coke Plant site (OU 2) on the eastern edge of the harbor, the PCB containment cells (OU 3) on the northern portion of OMC Plant 2 and in former Slip 3 in which thermally treated, PCB-impacted sediment and untreated PCB-contaminated soil are managed, and the OMC Plant 2 site (OU 4) north of the harbor. OMC Plant 2 is the source of the PCB contamination in Waukegan Harbor sediments, causing the harbor to be listed as an International Joint Commission (IJC) Great Lakes Area of Concern (AOC). In February 1992, OMC completed a sediment remediation

project in the harbor that entailed the dredging, treatment, and disposal of approximately 38,000 cubic yards (yd^3) of PCB-contaminated sediment from the North Harbor area. Dredged sediments were placed in a permanent containment cell constructed in the former Slip 3. Remediated sediments contained an estimated 1,000,000 pounds of PCBs with a maximum PCB concentration of 500,000 milligrams per kilogram (mg/kg, approximately equivalent to parts per million [ppm]). Sampling of surficial sediments conducted in 1996 indicated moderate levels (typically less than 25 ppm) of PCB contamination throughout the harbor from the North Harbor down to the Entrance Channel. OMC dredged the North Harbor to achieve a cleanup level of 50 ppm for PCBs.

The OMC remediation project also included removal or plugging of pipes that discharged PCBs into Waukegan Harbor (via the Slip 3 outfall). Other surface drainage systems were either excavated, covered and/or filled in as a result of the OMC cleanup action and no longer exist. There are currently no additional known sources contributing PCBs to the harbor.

In 2002, USEPA Region 5's Superfund Division conducted its second 5-Year Review of the OMC site to determine whether the cleanup actions implemented in 1992 remain protective of human health and the environment. USEPA determined that the 50 ppm cleanup level for PCBs (set forth in the 1984 Record of Decision [ROD]) in harbor sediments may not be protective because PCB levels in harbor-caught fish were still above action levels and the PCB remediation levels at other sediment sites were being set as low as 0.25 to 1.0 ppm. USEPA recommended that further investigations be conducted to determine the extent of PCB contamination remaining in the harbor and to evaluate impacts of PCB levels in sediment on PCB levels in the fish (USEPA, 2002).

Summary of Recent USEPA Investigations

Additional investigations were conducted in the harbor by the USEPA's Great Lakes National Program Office (GLNPO) in January 2003, January 2005 and November 2006 through March 2007. The GLNPO investigations included the following:

- **Sediment core and till sampling**—Collection and laboratory analysis of sediment core samples from the top of the sediment to the till surface from 90 locations throughout the harbor (includes selected sample data from 2003). A total of 600 samples were analyzed for PCBs. In addition, 53 samples were analyzed for geotechnical characteristics in 2005 through 2007.
- **Containment cell sampling**—Collection of material from a total of 10 locations in the West Containment Cell (4 locations) and the East Containment Cell (6 locations) to determine characteristics of the materials within the cells.
- **Bulk sediment sampling**—Bulk sediment collected from six areas within the harbor to provide representative samples for treatability testing of dewatering and wastewater processes.
- **Harbor water sampling**—Collection and laboratory analysis of both undisturbed and disturbed water samples to evaluate water quality of the harbor and the impacts to water quality as commercial ships enter and leave the harbor.

Major Findings

Physical Site Characteristics

Waukegan Harbor is an active harbor that currently supports recreational and commercial shipping. The harbor is a largely man-made structure that comprises 35 to 40 acres, with water depths varying from 8 to 24 feet. Nearly the entire harbor is bordered by steel sheet piling except in the Marina and along both of the north and south piers. The harbor has no tributary flow.

The generalized stratigraphy of the sediments in Waukegan Harbor (from highest elevation to lowest elevation) includes the following:

- Soft, organic silt and/or clay with relatively high organic content and moisture content ranging in thickness from about 0.5 to 10.5 feet.
- Loose to moderately dense, medium-grained sand with some silt and clay with approximately half the amount of organic and moisture content as measured in the overlying or underlying silts and clays.
- Very stiff, firm, silty clay till with trace sand, low plasticity, and relatively low moisture content encountered beneath softer sediment at depths ranging from -12 to -29 feet low water datum (LWD).

The total volume of sediment within all of the Waukegan Harbor segments except the Approach Channel is estimated to be more than 578,000 yd^3. Lake Michigan influences Waukegan Harbor by the nearly continual exchange of water between the lake and harbor caused by wind-induced seiches and mixing from direct waves entering the harbor through the Entrance Channel. Propeller and bow-thruster movements from large ships and boats also re-suspend and move sediment.

Nature and Extent of Contamination

Harbor Water

Historical sample results for the harbor indicated water quality conditions were worse in the innermost reaches of the harbor and improved toward the harbor mouth. Ammonia, cyanide, phenols, and dissolved oxygen were at concentrations causing the most concern. Harbor water samples were collected during the 2007 GLNPO investigation to evaluate the effects of ship propellers on re-suspending sediment and the resulting water column contaminant concentrations. The analytical result for the baseline sample (collected prior to shipping activity) included detections of phosphorus, total ammonia nitrogen, hardness, total organic carbon, total suspended solids (TSS), total volatile solids, arsenic, copper, and mercury. Total PCBs were not detected in this "undisturbed" baseline sample. Mercury was the only constituent in the baseline sample with a concentration (1.4 ng/L) that exceeds its criteria based on the Illinois Water Quality Standards (1.3 ng/L).

PCBs in Sediment or Clay Till

The horizontal and vertical delineations of PCBs in the sediment and till were evaluated based on total PCB concentrations rather than individual Aroclor concentrations. The analytical data indicate that two Aroclors (1016 and 1232) were not detected in any of the samples. Therefore, the calculation of total PCBs includes the five Aroclors detected in harbor sediment: 1221, 1242, 1248, 1254, and 1260. The method used to calculate total PCB concentrations for each sample consisted of summing the concentration of each detected Aroclor plus one-half the reporting limit (RL) for all non-detected Aroclors. For instances in which all Aroclor values were at or below the limit of detection, one half of the RL for each Aroclor was used to represent the "Total" value, even though none of the individual Aroclors were detected—on figures and tables depicting this total value, a "ND" (not detected) has been noted next to the value.

Sediment

Of the five separate PCB compounds detected within Waukegan Harbor sediments, Aroclor 1248 was detected at both the highest concentration and most frequently. The maximum PCB concentrations in sediment were detected in the vicinity of the North Harbor, Inner Harbor, and Marina, with the highest PCB concentration of 36.6 ppm from a sample collected in the Marina. Although there are some exceptions, the highest PCB concentrations generally occurred in sediment at depths of less than 3 feet.

The PCB concentration levels and sediment thicknesses found in the various harbor segments are summarized below:

- **Slip 4**—Sediment thickness is consistent within the slip, ranging between 7 and 13 feet. The average concentration of total PCBs in the Slip 4 sediment is 0.21 ppm, with - concentrations ranging - between 0.24 and 0.45 ppm at locations where at least one Aroclor was detected.

- **North Harbor**—The sediment in the North Harbor ranges from 0 feet to a thickness of approximately 14 feet with total PCB concentrations exceeding 20 ppm in at least three locations. The average total PCB concentration in this segment is 4.9 ppm with concentrations ranging from 0.12 to 26.9 ppm at locations where at least one Aroclor was detected. The sediment from the northernmost portion of the North Harbor (i.e., closer to former source) contains the highest concentrations.

- **Inner Harbor Extension**—Sediment thickness in this segment ranges from 0 feet to 9 feet with a small zone in the southern-most portion that is 14 feet thick. The average total PCB concentration is 1.8 ppm with concentrations ranging from 0.14 to 9.3 ppm at locations where at least one Aroclor was detected.

- **Inner Harbor**—The main shipping channel of the Inner Harbor has almost no measurable thickness of sediment. The sediment along the northwestern and southwestern sidewalls were measured to be up to 10 and 14 feet, respectively. The southern portion of the Inner Harbor has up to 11 feet of sediment. Higher concentrations (up to 7.47 ppm) of total PCBs in sediments were detected at depths of about 6 feet. The entire sediment column in the western portion of the Inner Harbor (contiguous with the Marina) was found to be contaminated with total PCB concentrations ranging from 1.7 to 9.6 ppm. The average total PCB concentration of the

entire Inner Harbor segment is 4.0 ppm, with a concentration range of 0.13 to 32.3 ppm at locations where at least one Aroclor was detected.

- **Slip 1**—The sediment thickness in Slip 1 ranges from less than one-tenth of a foot where boat traffic is centered to almost 13 feet near the seawalls. The total PCB concentrations range from 0.51 to 16.7 ppm at locations where at least one Aroclor was detected with the highest concentration occurring in the northern portion. The average total PCB concentration in Slip 1 is 4.6 ppm.
- **Marina**—Sediment thickness in the Marina ranges between 2 and 14 feet. Consistent total PCB concentrations exist throughout the sediment column in the northernmost portion of the Marina. The average total PCB concentration in the Marina is 3.4 ppm with concentrations ranging from 0.10 to 36.6 ppm at locations where at least one Aroclor was detected.
- **Entrance Channel**—The Entrance Channel sediment thickness varies from approximately 2 to 8 feet along its length and up to 15 feet along the northern wall. The average total PCB concentration is 1.0 ppm with a concentration range of 0.079 to 8.4 ppm total PCBs at locations where at least one Aroclor was detected.
- **Outer Harbor** —The Outer Harbor has a sediment thickness range of between 6 and 15 feet. The average total PCB concentration for samples in this segment is 0.23 ppm with a concentration range of between 0.11 and 1.5 ppm total PCBs at locations where at least one Aroclor was detected.

Clay Till

Forty-four (44) samples throughout the harbor were taken from the interval including the top of the clay till beneath softer sediment. PCBs were detected in 15 of the 44 clay till samples, with total PCB concentrations range from 0.109 to 0.416 ppm at locations where at least one Aroclor was detected. The results indicate that the till is not significantly impacted by PCBs that occur in the unconsolidated sediment.

Asbestos in Sediment

The potential presence of asbestos in harbor sediment was evaluated due to numerous possible sources of asbestos located at least a mile north of the harbor entrance on Lake Michigan (University of Illinois at Chicago, 2005). Qualitative results for 54 asbestos samples collected from sediment throughout the entire harbor in 2005 indicated trace amounts (less than 1 percent present) of asbestos in 9 samples. Quantitative analysis of the 9 samples found only one sample containing trace amounts chrysotile (CH2M HILL, 2005)—a sample from the Entrance Channel from approximately 2 to 2.5 feet below the top of the sediment column.

In 2006, the U.S. Army Corps of Engineers (USACE) collected 12 sediment samples from the Outer Harbor segment and analyzed them for asbestos using a quantitative method—transmission electron microscopy (TEM). Of the 12 samples analyzed, 4 contained detectable levels of asbestos fibers ranging from 1 million to 3.9 million fibers per gram of respirable material (i.e., particles smaller than 10 micrometers [µm]). USEPA assumes that sediments within the inner segments of the harbor would contain smaller amounts of asbestos because they would be farther away from the possible source areas identified north of the harbor on Lake Michigan.

Fish Tissue

Fish samples have been collected from Waukegan Harbor (Station Code QZO-01) on an annual basis by IEPA since 1996 (with the exception of 2002). The average PCB concentration in all fish from the 2001 to 2005 data set (24 samples) was 2.62 mg/kg and from the 2003 to 2005 data subset (12 samples) was 0.57 mg/kg, supporting an overall trend of decreasing PCB concentration levels in fish tissue.

PCB Fate and Transport

PCBs strongly adsorb to soil particles, have low water solubility, are persistent in the environment (do not readily break down), and thus do not show much migration in a given environment. Adsorbed PCBs will move primarily with the sediments they are sorbed to—the amount of movement will depend on the location within the harbor. Sediment movement within and/or out of Slip 4, the northern end of the North Harbor, and the Marina is expected to be minimal—the only re-suspension of sediment within these segments would be due to recreational marine traffic. More transport within the harbor would be expected in Slip 1 and the navigational segments of the harbor because of re-suspension of shallow sediment from propeller wash by the deep draft commercial vessels. Very shallow sediments in the segments near the harbor entrance (Entrance Channel and Outer Harbor) would also be influenced by wind-induced seiches and waves entering the harbor.

Human Health Risk Evaluation

PCBs in Sediment

PCBs do not appreciably degrade or easily attenuate, but bioaccumulate in harbor fish that may be eaten by humans. In July 2003, USEPA evaluated the short- and long-term risks associated with PCB contamination existing in Waukegan Harbor sediments (Clark, 2003). Carp fillets taken from Waukegan Harbor in 2000 and 2001 averaged 4.5 and 3.8 ppm PCB, respectively, exceeding the State of Illinois' (State's) do-not-eat criteria of 1.9 ppm. PCB concentrations in other fish, such as rock bass (estimated to be 0.5 ppm for fillets) also exceeded the State's safe level for fish of 0.05 ppm PCB. The 2003 risk evaluation indicated that the average PCB level in the harbor area sediments needs to be reduced about five-fold to reach a cancer level of 1 in 10,000 (level for fish advisories) and about ten-fold to achieve an acceptable noncancer risk (Clark, 2003). In 2006, an additional risk evaluation was performed using fish tissue results collected during 2001 to 2005 and indicated that a surface-weighted average concentration (SWAC) of 0.2 ppm for harbor sediment will protect high-rate consumers of fish from the harbor.

Fish Tissue

In February 2006, the Illinois Department of Public Health (IDPH) issued a state-wide sports fish consumption advisory for Illinois waters that included the "Waukegan North Harbor of Lake Michigan" (the "Waukegan North Harbor" includes the entire Waukegan Harbor OU). IDPH recommended that meals of white sucker and sunfish taken from the harbor be limited to one per month due to the elevated levels of PCBs in fish. All other species caught in the harbor should follow the advisory for Lake Michigan fish concerning PCB and methylmercury levels (USEPA, 2007). In January 2008, IDPH updated the state-wide sports

fish consumption advisory for Illinois waters which includes "Waukegan North Harbor of Lake Michigan."

Asbestos

Because there were detectable levels of asbestos fibers in a small sample set collected from the Outer Harbor sediment, the USACE evaluated the potential risk to human health from potential reuse of the material. The 2006 evaluation by the USACE indicated there is no further risk evaluation required for the material, and that the Outer Harbor sediment could be re-used on land without further consideration of asbestos risk (USACE, 2006).

Ecological Risk Assessment for PCBs

Factors that limit Waukegan Harbor's value as a habitat include regular industrial boat traffic that stirs up and muddies the harbor water, dredging operations that disturb harbor sediments and affect surface water quality, and the lack of cover provided by the deep, vertical harbor walls (CH2M HILL, 1995). Terrestrial habitat exists immediately adjacent to the harbor, but is limited to maintained/mowed grassy areas (e.g., the adjacent Waukegan Manufactured Gas & Coke Plant site, the former Slip 3 containment cell, and Warren Siver Park), gravel areas, and paved parking lots. Wetland areas do not occur immediately adjacent to the harbor. None of these areas support significant terrestrial habitat.

Fish and macroinvertebrates reside in harbor waters and have limited or nonexistent mobility, indicating these species are likely to spend a major portion of their entire life cycle within the study area. The Lake Michigan sport fishing catch consists primarily of yellow perch, chinook and coho salmon, and steelhead, brown, and lake trout. Two state-threatened fish species, the longnose sucker and the lake whitefish, have been reported in Lake Michigan between Zion and Waukegan. The last sightings of these species were in 1985 for the longnose sucker, and in 1991 for the lake whitefish (CH2M HILL, 1995).

The USEPA completed a sediment toxicity study for the harbor in 1999, representing post-remediation conditions (USEPA, 1999b). The results of the study are generally applicable to current conditions as additional dredging activities have not been conducted and PCBs do not appreciably degrade or easily attenuate. The results of the study indicate that the PCB levels in the sediment samples used in this study were generally not lethal to amphipods but may cause a significant reduction in amphipod growth.

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Acronyms and Abbreviations

µg/L	micrograms per liter
µm	micrometers
ACM	asbestos-containing material
amsl	above mean sea level
AOC	area of concern
ATSDR	Agency for Toxic Substances and Disease Registry
ATV	all-terrain vehicle
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylene
CAG	Citizen Advisory Group
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
cm/s	centimeters per second
COD	chemical oxygen demand
CRA	Conestoga-Rovers & Associates
CTE	central tendency estimate
CWA	Clean Water Act
DNAPL	dense non-aqueous phase liquid
EJ&E	Elgin, Joliet, and Eastern Railroad
EJ&W	Elgin, Joliet, and Western Railroad
FDA	U.S. Food and Drug Administration
FS	feasibility study
GLLA	Great Lakes Legacy Act
GLNPO	Great Lakes National Program Office
GMS	groundwater modeling software
GPS	global positioning system
HSA	hollow-stem auger

IAC	Illinois Administrative Code
IBSP	Illinois Beach State Park
IDNR	Illinois Department of Natural Resources
IDPH	Illinois Department of Public Health
IEPA	Illinois Environmental Protection Agency
IGLD	International Great Lakes Datum, 1985
IJC	International Joint Commission
K_d	distribution coefficient
Koc	organic carbon partitioning coefficient
LWD	low water datum
mg/kg	milligrams per kilogram (approximately equivalent to parts per million)
mg/L	milligrams per liter
mL/g	milliliters per gram
MNA	monitored natural attenuation
NCP	National Oil and Hazardous Substances Contingency Plan
ND	non detectable
ng/L	nanogram per liter
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NSSD	North Shore Sanitary District
OMC	Outboard Marine Corporation
OU	operable unit
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PLM	polarized light microscopy
ppm	parts per million (approximately equivalent to mg/kg)
PRP	potentially responsible party
QA/QC	quality assurance/quality control
RBC	risk-based concentration
RI	remedial investigation

RL	reporting limit
RME	reasonable maximum exposure
ROD	Record of Decision
RTK-DGPS	real-time kinematic differential global positioning system
SVOC	semi-volatile organic compounds
SWAC	surface-weighted average concentration
TCLP	toxicity characteristic leaching procedure
TEM	transmission electron microscopy
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TSCA	Toxic Substances Control Act
TSS	total suspended solids
UIC	University of Illinois at Chicago
UCL	upper confidence limit
ULD	unconfined lake disposal
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound
WCP	Waukegan Manufactured Gas & Coke Plant site
yd^3	cubic yards

SECTION 1

Introduction and Background

1.1 Introduction

This Remedial Investigation (RI) report describes the physical and chemical condition of sediment located in the Waukegan Harbor (harbor) operable unit (OU) of the Outboard Marine Corporation (OMC) Superfund site. The RI evaluates the occurrence and concentration of polychlorinated biphenyls (PCBs) in harbor sediment in order to support anticipated future harbor cleanup decisions. In 1990 to 1992, OMC cleaned up a large amount of PCBs found in northern harbor area sediment. However, based on current PCB levels detected in harbor-caught fish, the U.S. Environmental Protection Agency (USEPA) and the Illinois Environmental Protection Agency (IEPA) concluded that there may still be significant concentrations of PCBs remaining in harbor sediment that should be addressed.

The information compiled in this RI report will be used to develop and evaluate potential remedial alternatives for the sediment contamination and to support USEPA's selection of an approach for site remediation. The results of the alternatives development and evaluation will be presented in a separate Feasibility Study (FS) report.

1.2 General Site Description

Waukegan Harbor is located in the City of Waukegan (City), in Lake County, Illinois, on the southwestern shore of Lake Michigan. The site is about 40 miles north of Chicago and 10 miles south of the Illinois/Wisconsin border (Figure 1). The harbor is a largely man-made structure constructed in the late 1800s and early 1900s and comprises 35 to 40 acres, with water depths varying from 8 to 24 feet. Nearly the entire harbor is bordered by 20- to 25-foot-long steel sheet piling except in the Marina and along both of the north and south piers. The harbor has no tributary flow. A natural inlet and portions of adjacent wetlands were filled to form the present shape of the harbor area. Waukegan Harbor sediments consist of very soft organic silt (muck) overlying or interlayered with sand or silty sand. Very stiff clay (glacial till) that ranges from 50 to 100 feet thick lies underneath the sand (IEPA, 1994; USEPA, 2002).

Based on the current uses and historical activities, the harbor has been divided into the following harbor segments (Figure 2):

- Approach Channel (outside of the investigation area)
- Outer Harbor
- Entrance Channel
- Inner Harbor
- Marina
- Inner Harbor Extension
- Slip 1
- North Harbor
- Slip 4

The federal navigation channel of Waukegan Harbor includes the Approach Channel, Outer Harbor, Entrance Channel, Inner Harbor, and Inner Harbor Extension. The Approach Channel is not included as part of this RI.

1.3 Background

As a requirement of the Great Lakes Water Quality Agreement, federal, state, and provincial governments must designate geographic Areas of Concern (AOCs) in the Great Lakes where conditions have caused, or are likely to cause, impairment of beneficial uses (IEPA, 1994). The International Joint Commission (IJC), USEPA, and IEPA designated Waukegan Harbor as an AOC in 1981. This designation was prompted by the discovery of high levels of PCBs in harbor sediments. In 1983, the OMC site was also placed on the National Priorities List (NPL).

USEPA Region 5's Superfund Division conducted its second 5-year r+eview of the OMC site cleanup actions in 2002 and determined that the 50 (parts per million [ppm]) PCB cleanup level set forth in the 1984 Record of Decision (ROD) to address the PCB-contaminated harbor sediments may not be protective because PCB levels in harbor-caught fish were still above action levels. USEPA recommended in the OMC *Second 5-Year Review Report* that further harbor sediment and fish sampling be conducted to re-evaluate the 50-ppm PCB cleanup level and deferred reaching a protectiveness determination until this work was completed. Further sampling and analysis of harbor sediment was conducted by USEPA's Great Lakes National Program Office (GLNPO) from 2003 to 2005. GLNPO delineated the extent of residual (i.e., > 1 ppm) PCB levels in the harbor, leading the Superfund Division to later expand the OMC site definition to include nearly the entire harbor.

1.3.1 Construction of Waukegan Harbor

Waukegan Harbor is one of seven Lake Michigan harbors maintained by the U.S. Army Corps of Engineers, Chicago District (USACE). The following information from the USACE web site (http://lrc.usace.army.mil/topics/waukhist.htm) briefly describes its involvement in Waukegan Harbor.

In 1879, in response to requests from the citizens of Waukegan, USACE formulated a plan for creating an artificial harbor off the shoreline. In 1882, the project was modified to include dredging an interior basin in the low ground between the shore and the bluff and connecting the artificial interior basin with the exterior basin by a narrow channel. The configuration of the outer basin consisted of two piers 850 feet apart at the shoreline (North Pier and South Pier) (Figure 2) and, while the southern pier extended straight out into the lake, the North Pier zigzagged toward the south pier until the distance between them was only 235 feet.

When harbor improvements began in 1880, the only lake trade was in tanning bark from Michigan and lumber for local use. In 1889, Waukegan became the terminal of the Elgin, Joliet, and Western (EJ&W) Railroad that connected with more than 30 railroads to all parts of the country. The Elgin, Joliet, and Eastern (EJ&E) Railroad constructed slips in the harbor. In the 1890s, interest in improving the harbor originated as a result of the population and industrial growth. The City of Waukegan dredged the channel between the piers and, in 1900, constructed a 412-foot timber dock. As a result of the City's dredging, a 17-foot-deep channel

was available for vessels carrying coal. A coal company equipped with modern coal-handling appliances obtained privileges at one of the slips. In addition, an elevator company with large grain elevators in South Chicago obtained dock privileges at a slip still to be constructed. Waukegan began to provide space for commercial concerns to avoid congestion of the Chicago Harbor. The River and Harbor Act of June 30, 1902, provided for a 20-foot depth at the harbor, extension of the piers, and construction of a breakwater. These projects were completed in 1904 (USACE, 2003).

1.3.2 Contamination Overview

Historical analytical data were used to establish general site conditions as documented in this overview. The historical data are summarized in the *Remedial Alternatives Array Document and Data Gaps Analysis Report for the Waukegan Harbor Area of Concern* (CH2M HILL, 2004).

USEPA has divided the OMC Superfund Site into four OUs, as indicated on Figure 2:

- OU 1: Waukegan Harbor.
- OU 2: The former Waukegan Manufactured Gas and Coke Plant (WCP) property east of the harbor.
- OU 3: PCB containment cells on the northern portion of OMC Plant 2 and in former Slip 3 in which thermally treated, PCB-impacted sediment, and untreated PCB-contaminated soil are managed.
- OU 4: The abandoned OMC Plant 2 property north of the harbor.

Outboard Marine Corporation Plant 2 and Waukegan Harbor

Plant 2 was a 1-million-square-foot facility in which OMC manufactured outboard engine parts from about 1949 until it declared bankruptcy in December 2000. The facility was the source of PCB contaminants in the harbor and has recently been shown to also have a large amount of chlorinated solvent beneath the building in the ground and groundwater (USEPA, 2002). OMC used hydraulic fluid containing PCBs as a lubricant in its aluminum dye casting machines from 1961 to 1972. Reports indicate that OMC purchased about 8 million gallons of PCBs. During the manufacturing process, some of the hydraulic fluid spilled into floor drains that discharged to an oil interceptor system, which then discharged to the North Ditch, a tributary to Lake Michigan. Some of the PCBs escaped from a portion of the oil interceptor, diversion, and pump system, and were released directly to Waukegan Harbor. This discharge was located in the western end of Slip 3, and the discharge on the northern portion of the property was to the Crescent Ditch (Figure 2). As a result, large quantities of PCBs were released into Slip 3 and on the OMC property in the North Ditch, Oval Lagoon, and Crescent Ditch, as well as in the Parking Lot.

The IEPA conducted effluent sampling of outfalls on Lake Michigan in an attempt to identify sources of PCB contamination. In 1976, IEPA notified USEPA that high concentrations of PCBs had been found in the discharge of the OMC plant. IEPA estimated a discharge rate of 9 to 10 pounds of PCBs per day (USEPA, 2000b). USEPA collected 15 sediment samples in 1976 and found levels of PCBs ranging from 0.1 milligrams per kilogram (mg/kg, approximately equivalent to ppm) east of the Entrance Channel to

4,200 mg/kg at the upper end of the harbor in Slip 3 (USEPA, 1976). By the time the discharge pipe to the harbor was sealed in 1976, about 300,000 pounds of PCBs had been released into Waukegan Harbor, and another 700,000 pounds had been discharged on OMC property. It has also been estimated that hundreds of thousands of pounds of PCBs were discharged into Lake Michigan (USEPA, 2002). Harbor sediment sampling in 1985 and 1986 by the Illinois Department of Energy and Natural Resources found the highest levels of PCBs in Slip 3 (17,251 ppm), with decreasing concentrations toward the harbor mouth (IEPA, 1994). The studies indicated that PCBs were distributed throughout the sediments of Waukegan Harbor, with about 50,000 cubic yards (yd^3) with concentrations above 50 ppm, and substantially more with concentrations above 10 ppm (USEPA, 1983).

The areas of concern within the harbor were former Slip 3 and the North Harbor, where large quantities of PCBs were deposited in the sediments as the result of OMC discharging PCBs and other fluids from its manufacturing facility (OMC Plant 2). Sediment PCB concentrations in former Slip 3 were greater than 500 ppm and PCB concentrations were between 50 and 500 ppm in the North Harbor. The PCB concentrations in Crescent Ditch, Oval Lagoon, and North Ditch ranged from 50 to greater than 10,000 ppm. Another area of concern was the nine-acre Parking Lot area, north of OMC Plant 2 building. PCB concentrations in this area were between 50 and 5,000 ppm.

Waukegan Manufactured Gas and Coke Plant

The 36-acre WCP site lies between OMC Plants 1 and 2 on the peninsula separating Waukegan Harbor on the west from Lake Michigan on the east (Figure 2). The EJ&E Railroad purchased the WCP site in 1893 and operated a railroad tie creosote wood-treating plant from about 1908 to 1917. The site was used as a large manufactured gas plant and then as a coke plant under various owners from 1928 through 1969. OMC purchased the WCP property in the 1970s and demolished the remaining coke plant structures. Between 1973 and 1989, OMC used the property for fire training. Other more recent uses include waste oil storage, public parking, stockpiling of sand from dredging operations, and snowmobile testing. Larsen Marine Service, Inc. (Larsen Marine) currently uses the northwestern portion of the site for seasonal boat and trailer storage.

Contamination at the WCP site was discovered during the cleanup of the Waukegan Harbor, when the replacement boat slip for former Slip 3 (i.e., Slip 4) was excavated on the coke plant property. The excavated material was tested and found to contain high levels of polynuclear aromatic hydrocarbons (PAHs). Further investigation at the WCP site revealed that arsenic and creosote contaminants in soil and high levels of ammonia, arsenic, phenol, and benzene in the groundwater.

1.3.3 Remedial Activities at the Outboard Marine Corporation Site

Outboard Marine Corporation and Waukegan Harbor

In 1984, USEPA selected a remedy consisting of onsite containment and offsite disposal that targeted three areas for remediation: the North Harbor and Slip 3, the OMC parking lot, and the North Ditch/Crescent Ditch/Oval Lagoon area. Components of the remedy were later modified, and embodied in a 1988 Consent Decree. In March 1989, the ROD was correspondingly modified and the Consent Decree was entered into the U.S. District Court in April 1989. By terms of the Consent Decree, OMC was to finance a Trust to implement the

cleanup and to ensure performance of the requirements of the Consent Decree. The final remedy for the harbor area included the following cleanup activities for OU 1, which included the creation of OU 3—the PCB containment cells (USEPA, 2002):

- A new boat slip (Slip 4) was built on the east side of the North Harbor on the WCP property to replace PCB-contaminated Slip 3. Larsen Marine was relocated from Slip 3 to this new slip.
- A double sheet pile cut-off wall was built to isolate Slip 3 from the North Harbor. A low permeability 3-foot-thick clay slurry wall was anchored 3.5 feet into the underlying clay till, and Slip 3 became a permanent containment cell.
- A total of 8,000 yd^3 of sediment in Slip 3 with PCB concentrations above 500 ppm were removed and isolated for treatment. About 30,000 yd^3 of sediment in the North Harbor with PCB concentrations between 50 and 500 ppm were removed and placed into the new Slip 3 containment cell.
- Two other containment cells (termed the East and West Containment Cells) were built with a similar design as the Slip 3 Containment Cell. The East Containment Cell encompasses the Plant 2 Parking Lot area and the land east of the lot, and the West Containment Cell encompasses the Crescent Ditch and Oval Lagoon. Before construction, all areas containing PCB contamination with levels of more than 10,000 ppm were excavated and removed for treatment. The soils excavated from the Parking Lot area did not require treatment before placement into the East Containment Cell because they were below the treatment criterion. About 5,000 yd^3 were removed from the North Ditch, 2,900 yd^3 of sediment and soil were removed from Oval Lagoon, and 3,800 yd^3 of sediment and soil were removed from Crescent Ditch.
- Material removed from designated hotspots was treated by a low-temperature extraction procedure that removed at least 97 percent of the PCBs by mass to separate the PCB oils from the sediments. Residual treated soil was placed in the West Containment Cell that was then closed and capped. About 30,000 gallons of extracted PCB oil were removed offsite for destruction at a Toxic Substances Control Act (TSCA)-approved facility.
- A water treatment plant was constructed and operated to treat water generated during construction and operation of the remedial action.
- An extraction well system was installed and operated at each containment cell to prevent the migration of PCBs from the cells by maintaining an inward hydraulic gradient.

In February 1992, USEPA completed the sediment remediation project in the harbor that entailed the dredging, thermal treatment, and disposal of PCB-contaminated sediment from the North Harbor. Remediated sediments contained an estimated 1 million pounds of PCBs with a maximum PCB concentration of 500,000 ppm (USEPA, 2000b). Final construction activities for OU 1 and OU 3 were completed in December 1994 and eliminated the known sources contributing PCBs to Waukegan Harbor. Operation and maintenance of the site is ongoing. Initial monitoring (1994 to 1996 samples) indicated that contaminant concentrations in harbor-caught fish had decreased. Warning signs from within the harbor were removed at that time because sampling had shown declines in concentrations to the same level as the greater Lake Michigan area (USEPA, 2000a).

However, results from fish tissue samples collected in 1997 through 2000 indicate that PCB concentrations are holding steady at 4 to 5 ppm, still above the U.S. Food and Drug Administration (FDA) action level of 2 ppm, and may be increasing. The USEPA concluded in the second 5-Year Review Report that the 50 ppm cleanup level for PCBs used as the remedial goal in the 1984 ROD may not be protective because PCB levels in harbor-caught fish were still above action levels and that current PCB cleanup levels at sediment sites are set as low as 0.25 to 1 ppm (USEPA, 2002).

Waukegan Manufactured Gas and Coke Plant

In the fall of 1989, during predesign field investigations, additional contamination in the form of PAHs was discovered in the soil area of the new Slip 4. The presence of PAHs reflects coking and wood treating operations that existed on the property before OMC's ownership. After consulting with USEPA, OMC constructed a temporary storage area, excavated the PAH-contaminated soil with concentrations above 5 ppm, and placed it in a temporary storage area covered with a high-density polyethylene liner. Because the area was within the former WCP property owned by OMC, USEPA designated the area as OU 2 of the OMC NPL site.

USEPA identified several potentially responsible parties (PRPs) for WCP. One of them, North Shore Gas Company, entered into an Administrative Order on Consent with USEPA in September 1990 for completion of an RI/FS. The RI was completed in February 1995 and a final FS was released in November 1998. USEPA signed an ROD on September 30, 1999 for the final cleanup of the WCP site based on a future industrial land use. The selected remedy consists of the following tasks (USEPA, 2002):

- The temporary stockpile of creosote-contaminated soils generated from the new slip construction and PAH-impacted soil from other areas would be excavated and sent offsite for thermal treatment by co-burning at a power plant or disposal in a suitable landfill.
- Arsenic-contaminated soil would be excavated and disposed of in an offsite Subtitle D landfill.
- Marginally contaminated soil (as defined by the ROD) would be covered by a combination of asphalt (parking lot), building(s), and/or a vegetated soil cover (cap).
- Groundwater would be cleaned up to remove arsenic, ammonia, and benzene using a mobile pump-and-treat program. After groundwater cleanup targets were met, a monitored natural attenuation (MNA) remedy would be implemented.

USEPA signed a Consent Decree with the PRPs in October 2004 to begin the remedial activities at the site. The first phase of cleanup involved the soil work that began in November 2004 and was completed in November 2005 when a 6- to 10-inch layer of clean soil was placed over the site and seeded. The City of Waukegan now maintains the site.

The groundwater cleanup work was initiated in the spring of 2007. Once the construction activities are completed (estimated as on or around July 2008), the 3- to 8-year mobile pump-and-treat program will commence (USEPA, 2007).

Outboard Marine Corporation Plant 2

When OMC declared bankruptcy in December 2000, it began shedding all of its assets, including its Waukegan-area properties. OMC Plant 1 was sold to Bombardier, Inc., and is not believed to require action under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). OMC Plant 2 had no buyers, so the bankruptcy trustee made a motion in bankruptcy court to abandon the facility. In August 2002, the OMC bankruptcy trustee, USEPA, and IEPA agreed to a settlement action whereupon the trustees would perform a limited number of cleanup actions inside the plant. These actions included the removal of chemical containers and the cleanup of certain highly contaminated areas. Once the trustees completed these cleanup actions, they legally abandoned OMC Plant 2 per the settlement agreement. Since abandonment by the trustees, USEPA conducted additional interior cleanup work to prevent the release of PCBs and other compounds into the environment. USEPA and IEPA expanded the OMC NPL site description to include OMC Plant 2 as OU 4 in December 2002.

USEPA completed certain RI/FS activities at the site in December 2006. In September 2007, USEPA signed an ROD that called for the demolition of the PCB-impacted portions of the OMC Plant 2 building and excavation of PCB- and PAH-impacted soil and sediment with offsite disposal of all contaminated materials. USEPA has started the remedial design for this work and anticipates that the design will be completed in spring 2008.

The ROD also indicated that cleanup remedies for solvent-impacted groundwater and dense non-aqueous phase liquid (DNAPL) contaminants would be identified after a pilot scale study evaluation of certain in situ cleanup methods is completed. The pilot-scale treatability testing for the in situ cleanup of chlorinated solvents in groundwater was initiated in December 2006 and this work will be completed in spring 2008. The DNAPL cleanup testing work is ongoing. Test results will be used to update the 2006 FS report and USEPA anticipates that it will release a proposed cleanup plan for groundwater for public comment in summer 2008.

1.3.4 Waukegan Harbor Dredging Activities

U.S. Army Corps of Engineers Dredging Operations

Both the Inner Harbor and the outer areas of Waukegan Harbor are affected by sediment accumulation. The breakwaters and piers that define and protect the Outer Harbor trap sandy sediments eroded from beaches at Illinois Beach State Park north of Waukegan and those carried by the littoral drift (IEPA, 1999). The Approach Channel and the Outer Harbor are maintained at a depth of -22 feet of low water datum (LWD), and the Entrance Channel and Inner Harbor have been periodically dredged to a depth of -18 feet LWD (USACE, 1995b).

USACE periodically dredges deposited sediments to maintain authorized depths in the federal navigational channel for commercial navigation. Each year, about 40,000 to 50,000 yd^3 of sand are dredged from the Approach Channel as an aid to navigation. USACE has dredged the Approach Channel since 1985 and as recently as January 2007. Dredged materials removed from the Approach Channel were classified as clean, sandy sediments that were suitable for unconfined lake disposal (ULD) or for use as nourishment materials for beaches. Before 1988, the sediment was deposited at a deep water, offshore site. The most recently used disposal site

for approach channel material is a near shore site (water depths from 6 to 12 feet), about 2,000 feet south of the Waukegan Port Authority South Harbor. All dredged materials from these areas have been disposed of in open water and, thus, have required water quality certification pursuant to Section 401 of the Clean Water Act (CWA).

Dredging of the inner portions of Waukegan Harbor, west of the North Pier, was discontinued after 1972 because the sediments were classified as polluted (USACE, 1989). The North Harbor area was partially dredged as part of the OMC Superfund cleanup completed in 1992. The Inner Harbor area has an authorized depth of -23 feet LWD, and was last dredged to -18 feet LWD in 1972. The main commercial users have altered normal shipping procedures (e.g., reduced ship loads) to accommodate shallow water depths in the harbor.

Dredging of Slip 1

In July 2003, the shipping companies that use Slip 1 (LaFarge, National Gysum, and St. Mary's Cement) funded the dredging of Slip 1. Before dredging, a composite sample of sediment in Slip 1 was collected to characterize the material for landfill disposal. The composite sample contained 0.424 mg/kg of PCBs (Aroclor 1248). Hard clay samples were also collected beneath the sediments at four locations using a hydraulic excavator from a barge. None of the clay samples contained detectable concentrations of PCBs, which confirmed that the clay till was not contaminated. The clay till was dredged with a clamshell bucket from a barge to a depth of 19 feet. Periodic sampling of excavated materials during the dredging also indicated that PCB concentrations in Slip 1 were relatively low (less than 1 ppm). The excavated materials were stabilized and sent to a landfill for disposal (Tanner Environmental, 2003).

Larsen Marine Service, Inc. (Slip 4)

Larsen Marine provides brokerage of boats, repair services, and docking for recreational boats in Slip 4. Because of the low lake levels, Larsen Marine dredged about 1 foot of soft sediment from Slip 4 in 2001 and an additional 1.5 feet from the eastern portion of Slip 4 in 2002. The 2002 operation was stopped because black, oily sediment was reportedly observed during an attempt to dredge between two piers (Piers 25 and 26) in the central portion of the slip along the southern wall adjacent to the WCP. In response to the report, Conestoga-Rovers & Associates (CRA), consultants working on the WCP project, collected five core samples from the area in April 2003. The sediment samples were collected from a small barge. Oily samples were not observed in any of the locations investigated. Three of the core samples were submitted to a laboratory for analysis. Low levels of PAHs and PCBs (0.22 to 0.76 mg/kg of Aroclor 1248) were detected in all of the samples (CRA, 2003).

In 2003, the dredging of the soft sediments was completed in the western portion of Slip 4 using a small backhoe on a barge. The slip has a depth of about 11 feet in the western portion and becomes shallower to about 4 feet at the launch ramp.

1.3.5 Previous Waukegan Harbor Investigations

Numerous investigations have been conducted in the harbor since the completion of the sediment remediation project in 1992, and information has been compiled and recorded in various documents. The sources for the analytical or geotechnical data used in the assessment for this report are presented in Table 1. Sediment depth and thickness data from

probing and the 2002 Citizen Advisory Group (CAG) investigation results were provided directly from USEPA.

TABLE 1
Summary of Information Sources

Investigation/ Document	Data Type	
	Analytical	Physical/Biological
Report of Findings, Waukegan Harbor Sampling and Analysis (USACE, 1995a)	Analytical results from 9 core samples of unconsolidated sediment. Samples were analyzed for landfill acceptance that included chlorine, reactive cyanide, free liquids, moisture content, specific gravity, pH, PCBs, toxicity characteristic leaching procedure (TCLP) inorganics[a], TCLP volatile organic compounds (VOCs), TCLP phenol, and TCLP semivolatile organic compounds (SVOCs).	Sample descriptions summarized in table. Additional analysis includes that for specific gravity, total solids, and free liquids.
Report on the Collection of Sediment Samples from Waukegan Inner Harbor (QST Environmental Inc., 1998)	Analytical results from 9 core samples consisting of 9 unconsolidated sediment samples and 3 clay or hardpan samples. Samples were analyzed for VOCs, SVOCs, pesticides/PCBs, total metals[b], ammonia as nitrate, chemical oxygen demand (COD), total organic carbon (TOC), total Kjeldahl nitrogen, total recoverable petroleum hydrocarbon, total phenol, total phosphorus, cyanide, and asbestos.	Boring logs provided in report. Geotechnical analysis performed on 8 samples included that for moisture content, Atterberg limits, grain size analysis, specific gravity, and bulk density.
Evaluation of Toxicity and Bioaccumulation of Contaminants in Sediments from Waukegan Harbor, Illinois (USEPA, 1999b)	Analytical results from 18 surface grab samples and 1 core sample. Samples were analyzed for acid volatile solids and simultaneously extractable metals, total metals, organochlorine pesticides, PCBs, and PAHs[e]. Toxicity and bioaccumulation of contaminants from sediments were evaluated using chemical characterization of tissue samples, sediment toxicity tests with amphipods, sediment bioaccumulation tests with oligiochates, and sediment toxicity tests with Microtox® protocols.	Physical characterization included that for moisture content, grain size analysis, and total organic carbon.
*Investigation Report for Waukegan CDF Geotechnical Boring and Laboratory Program, Waukegan Illinois (*Patrick Engineering Inc., 2003)	Analytical results from samples collected from 15 environmental borings and 2 structural borings obtained directly by USEPA. Samples were analyzed for ammonia as nitrogen, phenol, metals[c], PCBs, benzo(a)pyrene, TOC, total volatile solids, and total solids.	Boring logs provided in report. Geotechnical analysis performed on samples from the 2 structural borings and included unconfined compressive strength as measured by pocket penetrometer and moisture content.
CAG, 2002	Analytical results from samples collected from cores collected at 8 locations in Inner Harbor and Entrance Channel. Samples were analyzed for metals[d]; ammonia as nitrogen; phosphorus; total Kjeldahl nitrogen; benzene, toluene, ethylbenzene, and xylene (BTEX); PCBs; PAHs[e]; TOC; phenol; total solids; and asbestos.	
Sediment Sampling Event, Waukegan Harbor Slip Number 4 (Letter report submitted to USEPA by CRA, 2003)	Analytical results from 3 sediment samples collected from cores in Slip 4. Samples were analyzed for arsenic, PCBs, PAHs[e] and total petroleum hydrocarbons (TPH) (as diesel).	
USEPA, 2003		Sediment thickness and depths measured at 197 locations based on probe measurements.

TABLE 1
Summary of Information Sources

Investigation/ Document	Data Type	
	Analytical	Physical/Biological
Data Evaluation Summary Report, Waukegan Harbor Area of Concern, Waukegan, Illinois (CH2M HILL, 2005)	Horizontal and vertical extent of PCB material greater than 1 ppm within the harbor. Sediment core samples for PCB, TOC, asbestos, and geotechnical analysis identified as"WH-SD001 – WHSD059: • 457 PCB samples from 59 locations • 44 geotechnical samples from 11 locations • 82 total organic carbon samples from 27 locations • 54 asbestos samples from 11 locations	Geotechnical and bioavailability characteristics of the material (based on total organic carbon)
Data Evaluation Summary Report, Waukegan Area of Concern, Waukegan, Illinois (CH2M HILL, 2007)	Bulk sediment samples for geotechnical analysis and treatability tests for various dewatering and wastewater treatment processes identified as Area A – Area F. Horizontal and vertical extent of PCB material greater than1 ppm along harbor seawalls and marina docks and in Slip 1. Sediment core samples for PCB, asbestos, and geotechnical analysis identified as WH-SD060 – WH-SD082: • 161 PCB samples from 23 locations • 3 geotechnical samples from 3 locations • 7 asbestos samples from 7 locations Site water samples identified as SSD-001 – SSD-005 OMC Plant 2 containment cell soil samples for geotechnical and chemical analysis identified as WH-SO-01E through WH-SO-06E and WH-SO-01W throughWH-SO-04W.	Geotechnical characteristics of dredged material and dewatered dredge material, containment cells on the OMC Plant 2 site

[a] TCLP inorganics included copper, mercury, nickel, zinc, silver, arsenic, barium, cadmium, chromium, and lead.
[b] Total metals included arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, and zinc.
[c] Metals included arsenic, barium, cadmium, chromium, copper, iron, lead, mercury, nickel, and zinc.
[d] Metals included antimony, arsenic, barium, cadmium, chromium, copper, lead, nickel, and zinc.
[e] PAHs included acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzoa)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, chrysene, Dibenz(a,h)anthracene, fluoranthene, fluorene, Indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

A summary of the analytical and geotechnical results from the previous investigations are presented in the *Remedial Alternatives Array Document and Data Gaps Report* (CH2M HILL, 2004).

1.4 Overview of the Remedial Activities

As described in the previous sections, the OMC remediation project also included removal or plugging of pipes that discharged PCBs into Waukegan Harbor (via the Slip 3 outfall). Other surface drainage systems were also excavated, covered, or filled in as a result of the OMC cleanup action and no longer exist. There are currently no additional known sources that are contributing PCBs to the harbor.

As part of their second 5-year review, USEPA deferred its long-term protectiveness determination until further information was obtained by re-sampling the sediments and

evaluating impacts of PCB levels in sediment on PCB levels in the fish (USEPA, 2002). This section briefly describes the additional investigations conducted by USEPA. The evaluation of the data is presented in the following sections of this RI report.

1.4.1 Investigation Activities

The additional investigations were conducted by the USEPA's GLNPO in January 2003, January 2005, and November 2006 through March 2007. The GLNPO investigations are described in the two data evaluation summary memorandums cited in Table 1 and are summarized below.

Sediment Core Sampling

Sediment cores from the top of the sediment to the till surface were collected from a total of 90 locations throughout the entire harbor (2003, 2005, 2006, and 2007 data). The objective of the collection of the sediment cores was to delineate the horizontal and lateral extent (and estimate volumes) of the PCB-containing sediment within the entire harbor and assess the geotechnical characteristics of the sediment in the navigational channel.

The locations of the sediment cores were initially identified using data from previous investigations and were situated to provide lateral coverage of the entire harbor (i.e., on an approximate 300-foot triangular grid). The sampling barges were guided to proposed core locations using a hand-held global positioning system (GPS) unit. The position of the location was then marked with survey flags and a final surveying of the marked location was compiled using real-time kinematic differential GPS (RTK-DGPS) equipment.

Prior to drilling, the depth to the top of the sediment below the water surface was measured at each location. Drilling and sampling of sediment cores was accomplished using hollow-stem auger (HSA) drilling from drill rigs mounted on barges. The HSA was lowered to the top of the sediment surface and allowed to penetrate the sediment under its own weight, and then a piston sampler or split-spoon sampler was driven into the sediment within the HSA. (A split-spoon sampler was used for all locations where geotechnical samples were collected from the sediment core). Sampling continued until the sediment/clay till interface was encountered—a clay till sample was only collected if till collection was specified at that given location. After the sediment core was described, selected intervals of the material were placed into sample jars for offsite laboratory PCB analysis in accordance with the USEPA-approved field sampling plan. Several "undisturbed" samples were collected using lexane liners to accommodate geotechnical testing. Geotechnical parameters included specific gravity, Atterberg limits, moisture content, bulk density, grain size, and organic content. A subset of samples was also submitted for asbestos analysis.

Containment Cell Sampling

A potential disposal option for the dredged harbor sediment is to consolidate the sediment along the northern portion of the OMC Plant 2 property, possibly on and/or adjacent to the existing containment cells. Samples were collected from a total of 10 borings on the West Containment Cell (4 locations) and East Containment Cells (6 locations) to determine the characteristics of the materials within the containment cells (Figure 2). The samples were collected using an all-terrain vehicle (ATV) drill rig and HSA drilling and sample collection

methods. The selected soil samples were collected for PCBs, paint filter, and standard proctor analyses.

Bulk Sediment Sampling

Bulk sediment sampling was conducted to provide representative samples for treatability testing of dewatering and wastewater treatment processes. The bulk sediment samples were collected from six different areas (Figure 3) within the harbor to represent a reasonable range of depositional environments and physical characteristics that will be encountered during a sediment removal action. Several bulk samples were collected from each of the six areas and blended into a single composite sample analyzed for geotechnical and treatability parameters. The bulk sediments were collected either using coring methods (as previously described) and composited or alternately using a clamshell bucket, depending on the target sample depth and the volume of material to be sampled. The sampling barge was outfitted with a crane hoist equipped with a 1.5-yd^3 clamshell bucket for bulk sediment collection. The bucket was lowered to a maximum depth beneath the top of the sediment of 4 feet.

Harbor Water Sampling

During the 2006/2007 investigation, harbor water samples were also collected to evaluate the water quality of the harbor and the impacts to water quality as commercial ships enter and leave the harbor. A baseline sample (SSD-001) was collected in the Inner Harbor approximately 4 hours after a commercial vessel, Sam Laud, docked at National Gypsum Company (Slip 1). Three additional harbor water samples plus one duplicate sample were collected from water behind the Sam Laud as it departed Waukegan Harbor. The samples were collected from approximately 6 feet below the water surface using a peristaltic pump placed within the wake created from the vessel. The sample locations are shown in Figure 3. The water samples were collected and submitted to IEPA laboratories in Champaign and Springfield, Illinois. Samples were also submitted to Severn Trent Laboratories in North Canton for low-level mercury analysis.

1.4.2 Remedial Alternatives Development and Design Activities under the Great Lakes Legacy Act

A group of area stakeholders, including USEPA, IEPA, local industries, and the City of Waukegan, Lake County (IL) and others gathered to evaluate the existing data, determine data gaps, and identify additional data required to develop and evaluate a remedy for the PCB-contaminated sediment to be partially paid for with Great Lakes Legacy Act (GLLA) funds. Development and evaluation of remedial action alternatives for the Waukegan Harbor AOC was described in a November 2004 report that was followed by a preliminary design process report in 2005 and a basis of design report in 2007. The results of the stakeholder efforts under GLNPO are presented in the following documents:

- *Remedial Alternatives Array Document and Data Gaps Analysis Report, Waukegan Harbor Area of Concern* (CH2M HILL, 2004)
- *Preliminary Design Document, Waukegan Harbor Area of Concern* (CH2M HILL, 2005)
- *Basis of Design/Design Criteria Report, Waukegan Harbor Area of Concern* (CH2M HILL, 2007)

Plans have now shifted to formulate and implement a harbor cleanup action under the Superfund process using the recently generated data. This RI report presents the evaluation of the recent data generated by the GLNPO investigations.

SECTION 2

Physical Site Setting

2.1 Local Demography and Land Use

2.1.1 Current Conditions

Waukegan Harbor is an industrial and commercial harbor used by lake-going freighters and recreational boaters. At one time, the Inner Harbor consisted of three operating slips (Slip Nos. 1 through 3). At a later date, Slip 2 was filled in and National Gypsum Company Inc. ("National Gypsum") built a plant on the site. Slip 3 was taken out of service in 1991 as part of the remedial activities for the OMC site and made into a permanent containment cell by constructing a cutoff wall in the harbor (Figure 2). Slip 4 was constructed to replace Slip 3, and officially opened to the public in July 1991. Slip 4 is used for repair, supply, and as docking facilities for private boats (Larsen Marine). Presently, Slip 1 is the only operating slip for commercial traffic (barges are also situated within the North Harbor next to National Gypsum property). Recreational boat traffic uses Slip 4 and the public marina located in the southwest corner of the harbor.

The Lake County Board and the City of Waukegan classified land use areas in Lake County in 1987. Land surrounding the northern portion of Waukegan Harbor has been classified as urban, while the beach areas and water filtration plant properties have been classified as open space areas. The remaining land in the immediate harbor area is classified as special use (Lake County) or residential (City of Waukegan). The Waukegan Port District property is located within this special use area.

The current land use surrounding the harbor is primarily marine-recreational and industrial, but also includes utilities and a public beach on the east side of the harbor peninsula (Figure 2). During 1990, there were about 75 commercial ships docking at Waukegan Harbor. Most of the waterborne commerce in Waukegan Harbor is for receiving building cement and gypsum that are offloaded from commercial ships in Slip 1 for further distribution by land. National Gypsum, LaFarge North America, Inc. ("LaFarge," also includes LaFarge Building Materials Inc.), and St. Mary's Cement, Inc. are the major commercial users of the harbor. National Gypsum stores gypsum in large outdoor piles north of Slip 1. St. Mary's Cement stores cement in silos located west of the slip, and LaFarge has silos located to the south of Slip 1.

The Port of Waukegan is also home to a number of small- and large-scale industries that do not receive raw materials or supplies by ship including Bombardier Motor Corporation of America ("Bombardier" located in the former OMC Plant 1). OMC Plant 2 and the WCP are closed industrial sites located around the upper Waukegan Harbor area.

Two marine contractors, Edward E. Gillen Company and Larsen Marine, have operations located on the harbor. Larsen Marine, located on the North Harbor along Slip 4, is the largest lakefront yacht dealer in the Chicago metropolitan area. The company provides yacht

brokerage for new and used powerboats and sailboats and offers marine repair services. Larsen Marine can accommodate approximately 25 recreation boats in Slip 4. Edward E. Gillen Company is a dredging and shore restoration contractor who has operating space just east of National Gypsum where their operations barges are typically moored within the North Harbor, with on-land operations located just west of the former OMC Plant 1 (Bombardier).

Currently, the Waukegan Water Utility water treatment plant lies north of the Entrance Channel (Figure 2). The plant has a nominal capacity of 18 million gallons per day. The principal raw water intake structure is located 6,200 feet southeast of the North and South Piers and is in about 25 feet of water. An emergency intake structure is located 1,275 feet southeast of the piers and is in roughly 20 feet of water. The old emergency intake structure located in the north seawall of the Waukegan Harbor channel is sealed and is not in use (IEPA, 1994).

The Waukegan Harbor area is also a major recreational area. The Waukegan Port District operates 1,000 slips and moors for recreational boats. The public beaches to the north and east of the harbor are used for swimming, sunbathing, and public events. Recreational facilities in the harbor area, in addition to the boat mooring and public launching areas, include Waukegan Yacht Club, the Warren Siver Park, and the North and South Piers. The Yacht Club owns a clubhouse adjacent to the harbor. The Warren Siver Park is a small park immediately west of the boat mooring areas. The South Pier is used for sightseeing, sunbathing, bird watching, walking, and fishing. This pier ends at the lighthouse that marks the entrance to the harbor.

2.1.2 Assessment of Potential Future Use

In December 2000, OMC declared Chapter 11 bankruptcy and began liquidation in August 2001. The WCP and OMC Plant 2 properties were put up for sale by the Bankruptcy Trustee at this time. The City purchased the WCP property on June 26, 2002 and took title to the OMC Plant 2 property on September 30, 2005. The City and other entities are working to redevelop the harbor and lakefront areas by moving away from heavy industrial use towards a mixed residential and marine use. After purchasing the WCP site, the City re-zoned it from commercial-industrial to high-density-residential and has similar plans for the rest of the OMC properties.

In December 2003, the City of Waukegan amended its 1987 Comprehensive Plan to include the *Waukegan Lakefront – Downtown and Lakefront Master Plan* and supporting documents prepared by Skidmore, Owings & Merrill, LLP and its consulting team (City of Waukegan Ordinance No. 03-O-140). The Master Plan and documents provided by the City of Waukegan were reviewed with respect to the anticipated future land use of the OMC Plant 2 and surrounding properties. The master plan mandates the de-industrialization of the harbor front and North Harbor and stipulates that these areas be redeveloped for residential recreational and commercial (but not industrial) purposes. Specifically, the master plan calls for the following:

- Closing of the key manufacturing plants, reducing dependence on lake-based shipping, and developing the adjacent harbor area to a more diverse mix of recreational, residential, and commercial uses.

- Encouraging material storage, distribution, and industrial operations to relocate away from the North Harbor after 5 years.
- Designating the west side of the North Harbor for "Marina-Related Use," "Future Boat Launch," and 50 feet of continuous public access.

The City of Waukegan has also indicated that they are working with their Congressman on de-federalizing Waukegan Harbor and limiting the maximum draft of vessels entering the harbor to 10 feet (City of Waukegan, 2007). If the harbor is de-federalized, deep draft vessels will be prevented from entering the harbor, and a shift to developing the harbor area to a more diverse mix of recreational, residential, and commercial (but not industrial) land use would be possible.

Over the short term, none of the area businesses have indicated a willingness to leave their harbor locations and recreational and industrial use for the harbor will be maintained. However, because of the City's master plan, use of the harbor and surrounding properties near the harbor may be changing in the future.

2.2 Climate

Waukegan is situated on southwestern Lake Michigan and has a humid continental climate with hot summers (Encarta, 2008) and an annual average precipitation of 32.32 inches (IDcide, 2008). Rainfall is fairly evenly distributed throughout the year. The wettest month of the year is August with an average rainfall of 3.88 inches. The climate is warm during summer when temperatures tend to be in the 70s (degrees Fahrenheit) and very cold during winter when temperatures tend to be in the 20s (degrees Fahrenheit). The warmest month of the year is July with an average maximum temperature of 81.7 degrees Fahrenheit, while the coldest month of the year is January with an average minimum temperature of 12.0 degrees Fahrenheit. Temperature variations between night and day tend to be moderate during summer with a difference that can reach 20 degrees Fahrenheit, and fairly limited during winter with an average difference of 16 degrees Fahrenheit.

2.3 Topography

The general elevation of the City of Waukegan is 690 feet above mean sea level (amsl) (Sperling, 2008). The general topography of the land immediately adjacent to the harbor area from the Lake Michigan to the Zion Moraine Bluff to the west is relatively flat. Some slight variations exist between filled areas and natural ground. Manmade high areas include the gypsum storage pile on the National Gypsum property adjacent to the harbor. The bathymetry of Waukegan Harbor is discussed in later sections of this report.

2.4 Regional Geologic and Hydrologic Setting

The geologic and hydrologic settings presented below are discussed in terms of regional conditions and those encountered at the adjacent WCP site. The project datum utilized for water level description and/or for sediment level is the International Great Lakes Datum, 1985 (IGLD, 1985) of 577.5 feet amsl.

2.4.1 Geology

The on-shore geology near the harbor is characterized by near-surface fill materials that were placed over a fine-grained sand unit. The sand overlies a glacial clay till which in turn overlies a sequence of dolomitic bedrock formations. The till is about 80 feet thick and consists of a hard gray, lean clay with sand and some gravel. The surface of the till is irregular, and generally slopes gently downward from west to east beneath the peninsula (USEPA, 1999a).

At the WCP site, the fill deposits extend to 2 to 12 feet below ground surface (bgs). The fill typically consists of reworked sand deposits with demolition and construction debris, as well as WCP-related materials such as coal, coke, and slag. The naturally occurring material underlying the fill consists of medium-grained sand with gravel—the near lake lacustrine and beach deposits of the former glacial Lake Chicago—an expanded version of today's Lake Michigan. These materials are part of the Equality Formation (IEPA, 1991). The sand unit is generally 20 to 25 feet thick. It consists of a well-sorted fine to very fine sand containing 5 to 15 percent silt. Deeper portions of the sand unit typically show finer grain sizes than shallow portions. Measured porosity values range from 33 to 41 percent.

Silurian age dolomite comprises the uppermost bedrock in the area. This shallow bedrock is fractured and contributes to groundwater flow in the Silurian dolomite. The Maquoketa Group Shale underlies the Silurian dolomite and acts as an aquitard that separates the Silurian dolomites from the deeper bedrock units.

2.4.2 Hydrogeology

Lake Michigan and Waukegan Harbor serve as discharge areas for shallow groundwater from the area surrounding the harbor. Groundwater near the harbor is recharged by precipitation, which flows through the sand unit before discharging into the surrounding surface water. The sand unit is underlain by the very low permeability clay till. At the WCP site, groundwater in the sand was encountered at a depth of about 4 to 5 feet. Groundwater flow beneath the WCP site toward the harbor wall on the west was calculated to travel about 60 feet per year based on an estimated hydraulic conductivity of 30 feet per day (1.1×10^{-2} centimeters per second [cm/s]) for the sand aquifer. The groundwater discharges directly to the harbor through the sheet-pile joints and any gaps that may exist in the wall (USEPA, 1999a).

Based on the lake/harbor water exchange and groundwater discharge rates to the harbor, harbor waters provide net flows to mix with site groundwater at ratios of 6,000 to 1 to 800 to 1. The average mixing ratio is about 1,600 to 1. Groundwater flow to the harbor is a gradual phenomenon dispersed over a large area (USEPA, 1999a).

2.4.3 Hydrology—Lake Michigan

Lake Michigan influences Waukegan Harbor in several ways. Most significantly, the nearly continual exchange of water between the lake and harbor, caused predominantly by wind-induced seiches, prevents stagnation of the harbor water. Average wind-induced currents in and out of the harbor are sufficient to exchange the volume of water in the harbor in 1 to 8 days (USEPA, 1999a). The lake also causes mixing in the harbor by direct waves entering the harbor through the Entrance Channel. In addition, large ships and tug

boats re-suspend large amounts of sediment as a result of the use of the propellers and bow thrusters to maneuver within the narrow navigational channel.

An additional small tributary to Lake Michigan drains surface runoff from about 0.11 square miles of OMC and the North Shore Sanitary District (NSSD) property. This drainage system, which includes the North Ditch, also drains surface runoff from areas west of the OMC property, the railroad tracks, and large portions of the City of Waukegan stormwater runoff via the Gillette Avenue storm sewer that discharges to the western end of the North Ditch. The North Ditch is about 2,000 feet in length and varies in width from 10 to 20 feet.

The Waukegan River, passes south of the harbor area but does not contribute to harbor flow, and is a tributary to Lake Michigan and consisting of approximately 5.8 stream miles. The river's watershed area consists of about 9.68 square miles (IEPA, 1994).

2.5 Physical Characteristics of Waukegan Harbor

2.5.1 Drainage Area

Waukegan Harbor is contiguous with Lake Michigan and has no tributary flows. Therefore, any recharge/exchange of water to the harbor is through inflow/mixing from Lake Michigan water, precipitation, or minor amounts of groundwater discharge from onshore. The Waukegan Harbor drainage area is bounded on the north by the North Ditch, by the Zion Moraine bluff to the west, and the South Pier on the south. The Waukegan Harbor watershed consists of approximately 0.47 square mile of industrial, commercial, municipal, and open/vacant lands and receives stormwater runoff at seven discharge points, as well as from overland flow (IEPA, 1994).

2.5.2 Sediment Deposition

Based on historical dredging operations, USACE estimated the future anticipated shoaling rates and required dredging intervals for Waukegan Harbor, as shown in Table 2. The total annual shoaling rate is about 30,000 yd^3 of material (USACE, 1995b).

TABLE 2
Estimated Annual Shoal Rates

Harbor Section	Shoal Rate (yd^3/yr)	Dredging Interval (yr)
Approach Channel	25,000	2
Outer Harbor	1,500	10 or more
Entrance Channel	2,000	10
Inner Harbor	1,500	10 or more

Source: Waukegan Harbor Approach Channel Dredging, Tier 1 Sediment Evaluation (USACE, 1995b).

The estimated shoaling rates indicate that the majority of the shoaling takes place in the Approach Channel. Differences between the Approach Channel and other areas in shoaling rates and sediment chemistry indicate that the main source of sediment in the Approach

Channel is from littoral transport of Lake Michigan sands from areas north of Waukegan Harbor (USACE, 1995b).

Historical studies indicate that deposition of materials in the Outer Harbor is probably the result of beach sand overtopping the North Pier and passing through gaps in the sections of the pier (USACE, 1995b).

2.5.3 Sediment Properties

A summary of the physical properties of the sediment samples collected from Waukegan Harbor is provided in Appendix A. The generalized stratigraphy of the sediments in Waukegan Harbor is conceptually depicted on Figures 4 and 5 and includes (from highest elevation to lowest elevation):

- **Soft, organic silt and/or clay (OL, ML, MH, CL) with high organic contents and moisture.** The organic silt and clay layer was generally observed in samples throughout the harbor, except in the Inner Harbor Extension and the Outer Harbor areas. This material was encountered at depths of about -13 to -23 feet LWD and range in thickness from about 0.5 foot to 10.5 feet.
- **Loose to moderately dense, medium-grained sand with some silt or clay (SC, SM, SP, or SW).** The sands have a reduced amount of organic content and moisture content as measured in the silts and clays. The depth to the top of the sand layer ranged from about -6 to -24 feet LWD (average of -18 feet LWD). The thickness of the sand layer in the Outer Harbor area ranges from 6.5 to 10 feet, in the Entrance Channel from 0.2 to 10.5 feet and, in the eastern portion of the Inner Harbor, about 4 feet. The sand in the rest of the Inner Harbor, Inner Harbor Extension, and the North Harbor was generally less than 1 foot thick (Figure 5).
- **Very stiff, silty clay till with trace sand (CL, ML).** The clay is firm with low plasticity and trace amounts of fine to coarse sand and shale containing relatively low moisture content. Boring logs from cores within the harbor indicate that the glacial till surface generally slopes to the east, ranging from -15.8 feet LWD in the North Harbor area (WIH-1197-007) to greater than -25 feet LWD in the Outer Harbor. Geotechnical data indicate that the clay till has an apparent unconfined compressive strength of 4.5 tons per square foot or greater (CH2M HILL, 2004).

In general, the amount of silt and clay decreases farther down in the sediment column. The amount of sand is dependent on the location within the harbor. In the Outer Harbor, the sediment is comprised of the sand deposited by wind from the nearby dune material that has settled over clay till (Figure 4). Progressing westward into the Entrance Channel and Inner Harbor, the silt/clay material is encountered above and sometimes mixed with or layered with the sand material. For example, within the Inner Harbor there is less access to Outer Harbor sand, so some of the material there is comprised of organic silt/clay suspended within the Inner Harbor by shipping traffic. From the Inner Harbor northward to the North Harbor (Figure 5), there is an even lower amount of sand present.

Figure 6 depicts the depth-weighted average percentage of "coarse" material (the amounts of sand plus gravel based on greater than a 200-sieve size) at a given core location based on geotechnical data (Appendix A). The majority of the Outer Harbor sediment column is

comprised of coarse soil types (greater than 50 percent). Entrance Channel sediment contains slightly less coarse material (26 to 53 percent), with further decreased amounts in the Inner Harbor and Marina with the exception of a few spots near the walls of these segments. The Inner Harbor Extension and North Harbor contain a range of coarse material between 7.2 and 56.8 percent, with 4 out of the 5 samples here containing less than 50 percent.

Figure 7 presents the distribution of TOC within harbor sediment. The harbor segment with the highest amount of organic carbon is the northern portion of the North Harbor—Slip 1. The southern portion of the Inner Harbor also has relatively higher amounts of TOC, indicative of areas where PCB contamination would have a relatively higher affinity for remaining sorbed to sediment particles.

2.5.4 Sediment Volumes

In order to estimate volumes of sediment in the Waukegan Harbor, the most recent bathometric survey data completed for the City in November 2006 was used to define the top of the sediment elevation. A total of 90 sediment core locations throughout Waukegan Harbor (Figure 3) from previous investigations were used to determine the elevation of the top of consolidated till surface. The sediment surface and clay till surface are presented in Figures 8 and 9, respectively, and the resultant sediment iso-thickness is provided on Figure 10. Sediment core data for each surface was input into a three-dimensional model (Groundwater Modeling Software v. 4.0 [GMS] produced by Environmental Modeling Systems, Inc.) and are summarized in Table 3. Based on the sediment core thickness data, there is about 578, 000 yd^3 of unconsolidated sediments on the bottom of Waukegan Harbor from the Outer Harbor inward.

TABLE 3
Summary of Sediment Depths and Volume by Harbor Segment

Harbor Segment	Top of Sediment (LWD IGLD85)	Top of Till (LWD IGLD85)	Thickness (ft)	Volume (yd^3)
Outer Harbor	-10.9 to -22.6	-25.6 to -30.1	4.8 to 17.3	218,000
Entrance Channel	-6.2 to -23.4	-21.6 to -28.1	0 to 19.6	89,000
Inner Harbor	-6.1 to -25.7	-20.8 to -26.9	0 to 18.7	79,000
Inner Harbor Extension	-5.1 to -25.9	-17.8 to -25.9	0 to 15.6	10, 000
Marina	-4.0 to -15.1	-11.9 to -26.9	2.8 to 19.3	118,000
Slip 1	-10.3 to -24.3	-19.4 to -24.3	0 to 12.5	5,000
North Harbor	-6.1 to -23.4	-17.9 to -23.4	0 to 14.6	36,000
Slip 4	-5.0 to -13.9	-18.0 to -21.5	5.7 to 13.3	23,000

Note: Surface elevation and sediment thickness values were obtained from surfaces modeled by Groundwater Modeling Software v. 4.0 ([GMS] produced by Environmental Modeling Systems, Inc.) using sediment core data.

SECTION 3

Nature and Extent of Contamination

The quality of harbor water and sediment are impacted by overland flow, storm sewer discharges, and permitted discharges. Land use in the watershed drainage area to the harbor is primarily commercial and industrial, with significant areas of railroad and highway right-of-way, and lesser areas of open and urban residential space. Both municipal and private storm sewers discharge to the harbor. A portion of the surface area of downtown Waukegan drains to the harbor by storm sewer. Discharges from industrial activities to Waukegan Harbor include non-contact cooling water and other permitted discharges under the National Pollutant Discharge Elimination System (NPDES) program, and the contribution of PCB-contamination by historical OMC operations. In the early 1980s, oil from releases at the railroad tracks located west of the harbor washed through the Madison Street sewer system into Waukegan Harbor (IEPA, 1994).

The risk evaluation conducted by USEPA (see Section 5 of this report) indicated that because PCBs do not appreciably degrade or attenuate, they have remained bioavailable in the harbor. Other chemicals detected in the sediments, such as asbestos, arsenic, and benzo(a)pyrene, are at very low levels in sediments and, unlike PCBs, will not bioaccumulate appreciably in fish. The non-PCB constituents would not, therefore, cause significant health risks to persons swimming or having direct contact with sediments (Clark, 2003). Therefore, the following discussion of chemical characteristics of media within Waukegan Harbor focuses mainly on PCBs. Data summarizing the amount of asbestos in harbor sediment is also presented from work performed for the Outer Harbor by USACE.

3.1 Surface Water

Water samples were collected at seven stations in the Waukegan Harbor area by IEPA in November 1990. Five locations were within the harbor, one at the Public Beach, and one outside the South Marina. The analytical results were compared to the then-current Illinois water quality standards, including Lake Michigan, Public Water Supply, and General Use Standards (35 Illinois Administrative Code [IAC] 302). Water quality conditions were worse in the more enclosed portions of the harbor and tended to improve toward the harbor mouth. Ammonia, cyanide, phenols, and dissolved oxygen were at concentrations causing the most concern. All samples contained concentrations of total phosphorus, ammonia, and sulfate that exceeded their respective standards. In addition to having higher concentrations, harbor samples also exceeded the standards for pH, dissolved oxygen (percent saturation), chloride, phenols, and conductivity. PCBs were not detected in any of the collected water samples (IEPA, 1999).

Additional information on Waukegan Harbor was collected in 2007 when samples were collected to evaluate impacts to water quality as commercial ships entered and left the harbor, re-suspending sediment via propeller wash. A baseline sample (SSD-001) was collected in the Inner Harbor approximately four hours after a commercial vessel, Sam Laud, docked at National Gypsum in Slip 1 on the west side of the harbor. Total PCBs were

not detected in this baseline sample. Three additional samples (SSD-002 through SSD-004) and one field duplicate were collected from behind the Sam Laud as it departed Waukegan harbor. The samples were collected from approximately 6 feet below the water surface using a peristaltic pump placed within the wake created from the vessel. Figure 3 includes the water sample locations and Table 4 provides a summary of analytical results and the Illinois Water Quality Standards (IAC 302, Subpart E). These criteria were established using chronic human health or wildlife water quality standards (IEPA, 2006). A comparison of the standards with the results from the baseline water quality sample indicates only mercury was detected at a concentration above its respective criteria (detected at 1.4 ng/L versus a standard of 1.3 ng/L).

3.2 Sediment and Till Surface

Five PCB compounds (Aroclors 1221, 1242, 1248, 1254, and 1260) have been detected in historical and recent data within Waukegan Harbor sediments or clay till samples. The harbor has been dredged previously in order to maintain access for freighters, barges, and private boats. Both dredging and passage of boats cause sediments in the harbor to be routinely disturbed. Such disturbances mix sediments into the water column, disrupt the benthic zone, and influence harbor water quality.

3.2.1 PCB Detection and Extent

The horizontal and vertical delineations of PCBs in the sediment and till were evaluated based on total PCB concentrations rather than individual Aroclor concentrations. The analytical dataset indicates that two Aroclors (1016 and 1232) were not detected in any of the samples. Hence, the calculation of total PCBs includes the five Aroclors detected in harbor sediment: 1221, 1242, 1248, 1254, and 1260. The method used to calculate total PCB concentrations for each sample consisted of summing the concentration of each detected Aroclor plus one-half the reporting limit (RL) for all non-detected Aroclors. For instances in which all Aroclor values were at or below the limit of detection, one half of the RL for each Aroclor was used to represent the "Total" value, even though there were no detections—on figures and tables depicting this total value, a "ND" (not detected) has been noted next to the value.

Total PCB concentrations for samples of both sediment and underlying clay till collected by USEPA between 2003 and 2007 are summarized in Table B-1 in Appendix B. The frequency and distribution of total PCBs in the Waukegan Harbor sediments are based on the data from 600 sediment samples collected from 90 sediment core locations throughout the harbor. At least one PCB Aroclor was detected in 83 percent of the samples (495 of 600 samples), and a value of half the detection limit was assigned for each Aroclor not detected. The most frequently detected and highest concentration of an individual PCB was Aroclor 1248. The average total PCB concentration within the harbor using all 600 sediment core samples, and including non-detect samples, is 2.2 ppm.

TABLE 4
Site Water from Behind Commercial Vessel Analytical Result Summary

Analyte	Units	Water Quality Criteria[d] Not to Exceed	Water Quality Criteria[d] 30-Day Average	Sample ID >> SSD-001 (Baseline) Location >> Inner Harbor Extension	SSD-002 Inner Harbor Extension	SSD-003 Inner Harbor	SSD-004 Entrance Channel
Phosphorus	mg/L	5	1	0.052 J	0.051 J	0.244 J	0.111 J
Total Ammonia Nitrogen (Apr-Oct)[e]	mg/L	2.9	0.6	--	--	--	--
Total Ammonia Nitrogen (Nov-Mar)[f]	mg/L	4.1	0.8	0.48 J	0.34 J	0.19 J	0.16 J
Hardness	mg/L	NA	NA	180	270	290	220
Total Organic Carbon	mg/L	NA	NA	2.2	2.6	2.4	2.3
Total Suspended Solids	mg/L	NA	NA	83	78	286	694
Total Volatile Solids	mg/L	NA	NA	9	8	18	39
PCBs							
Total PCBs[k]	µg/L	0.1[h]	0.1[h]	0.1 U	0.16	0.23 J	0.1 U
Pesticides							
Chlordane [a]	µg/L	0.01[h]	0.01[h]	0.01 U	0.01 U	0.01 UJ	0.01 U
DDT	µg/L	0.01[h]	0.01[h]	0.01 U	0.01 U	0.01 UJ	0.01 U
DDE	µg/L	0.01[h]	0.01[h]	0.01 U	0.01 U	0.0032 J	0.01 U
DDD	µg/L	0.01[h]	0.01[h]	0.01 U	0.01 U	0.01 UJ	0.01 U
Dieldrin	µg/L	0.01[h]	0.01[h]	0.01 U	0.01 U	0.01 UJ	0.01 U
Endrin	µg/L	0.086	0.036	0.01 U	0.01 U	0.01 UJ	0.01 U
Lindane (gamma-BHC)	µg/L	0.95[i]	0.5[k]	0.01 U	0.01 U	0.01 UJ	0.01 U
Total Metals							
Arsenic	µg/L	340	148	3.6	3.1	3.9	2.4
Cadmium	µg/L	6.6	3.2	3 U	3 U	3 U	3 U
Hexavalent Chromium	µg/L	NA	NA	20 U	20 U	20 U	20 U

TABLE 4
Site Water from Behind Commercial Vessel Analytical Result Summary

Analyte	Units	Water Quality Criteria[d] Not to Exceed	Water Quality Criteria[d] 30-Day Average	Sample ID >> SSD-001 (Baseline)	SSD-002	SSD-003	SSD-004
			Location >>	Inner Harbor Extension	Inner Harbor Extension	Inner Harbor	Entrance Channel
Total Chromium	µg/L	NA	NA	5 U	9.6 J	7.8 J	5 U
Trivalent Chromium [b]	µg/L	2,375	113.5	5 U	9.6 J	7.8 J	5 U
Copper	µg/L	19.2	12.4	10	14	15	10 U
Lead	µg/L	187.9	9.9	5 U	11	12	8.8
Mercury[k]	ng/L	1,700	1.3	1.4	4.9	10.4	17.7
Nickel	µg/L	623.7	69.3	5 U	5.2 J	5 J	5 U

Notes:
[a]Reported as Total Alpha & Gamma Chlordane
[b]Estimated value calculated as the difference between Total Chromium and Hexavalent Chromium
[c]Highlighted cells have values greater than the "Not to Exceed' limit.
[d]Based on IAC 302, Subpart E, unless noted. Metals criteria calculated using a hardness value of 140 mg/L
[e]Calculation based on Temperature = 26 degrees Celsius, pH = 8.3
[f]Calculation based on Temperature = 8.6 degrees Celsius, pH = 8.3
[h] This limit is based on the achievable Practical Quantitation Limit (PQL) as noted by IEPA (2006).
[l] This is a bioaccumulative compound and a criterion based on Acute Effects to Aquatic Life (IAC 302)
[k] This is a bioaccumulative compound and a criterion based on effects to Human Health (IAC 302)

Qualifier Key:
J - Estimated result
U - The value is below the specified reporting limit
UJ - Estimated detection limit
Abbreviations:
NA - Not Applicable
µg/L - microgram per liter
mg/L - milligram per liter
"--" - no data available

Sediment

The highest total PCB concentrations were detected in the vicinity of the North Harbor, Inner Harbor, and Marina (Figure 11), with maximum total PCB concentrations of 26.9 (WH-SD004), 32.298 (WH-09), and 36.64 (WH-SD027) ppm, respectively. One sample in Slip 1 (WH-SD065) has a total PCB concentration of 16.68 ppm, but remaining samples there are less than 5 ppm. The "maximum value" on Figure 11 represents the maximum concentration of total PCBs detected within the sediment column at that location on the map.

Of the 90 sediment core locations sampled within the harbor, 59 percent of the locations (53 of 90) contain at least 1 sample that has a total PCB concentration greater than 1 ppm. The depths (represented by the midpoint depth of the sample interval) of the maximum total PCB concentration from each core location are presented on Figure 12. In general, the highest total PCB concentrations were measured at depths of less than 3 feet—signified by the blue-colored sample locations shown on the figure. The area where the maximum PCB concentrations were typically encountered much deeper is between the Inner Harbor and the Marina where the sediment is thickest. Specifically, samples from locations WH-SD028, WH-SD025, and WH-SD022 contained maximum total PCB sample concentrations at depths between 9 and 11 feet.

Total PCB concentrations within the existing "surface" sediment are shown in Figure 13. In assembling this figure, the data were compiled to reflect a difference between sediment surfaces in navigational (Slip 1, Inner Harbor Extension, Inner Harbor, Entrance Channel, and Outer Harbor) versus non-navigational (Slip 4, North Harbor, and Marina) harbor segments. In navigational segments, it is assumed that the uppermost 2 feet of sediment are representative of the "surface" conditions, because the larger boats cause a relatively deep mixing due to their propeller size, etc. In non-navigational segments, boat traffic is limited to smaller, recreational craft with impacts from mixing that is assumed to be limited to the uppermost 0.5 feet. The higher concentrations (greater than 1 ppm) in the surface sediment are mainly grouped in the northern portion of the North Harbor, in Slip 1, in the Inner Harbor, the Marina, and Entrance Channel (Figure 13). In general, the highest surface concentrations are found within the North Harbor and Slip 1. The Inner Harbor Extension, Slip 4, and the Outer Harbor have lower PCB concentrations at the surface.

Cross sections depicting the vertical distribution of total PCB concentrations are provided in Figures 14A through 15B and cross section locations are indicated on Figure 10. Total PCB results greater than 1 mg/kg (ppm) are highlighted on the figures in bold font with a solid sample point.

Figures 14A and 14B depict sediment thickness and total PCB concentrations in the sediment or in underlying till for the west to east cross-sectional line extending from the Marina out through the Outer Harbor (cross-section line shown on Figure 10). Sediment thickness within the Marina ranges from 2 to 14 feet, mostly thickening to the east. The highest PCB concentrations in the Marina are at WH-SD-027 at an approximate depth of 3 feet (36.6 ppm). Sediment thickness begins to increase as the eastern end of the Marina segment transitions into the Inner Harbor segment.

Within the Inner Harbor, sediment thickness decreases to non-measurable in its center, coincident with the navigational channel of the segment. On the western end of the Inner Harbor at sample location WH-SD-029, there are multiple sample depths within the sediment column that exceed the 1 ppm value, with the highest being 14.3 ppm at an approximate depth of 11 feet. This area represents a thick wedge of sediment that is impacted with PCB concentrations throughout. Farther east, the Entrance Channel sediment thickness varies from approximately 2 to 8 feet through the center, but up to 15 feet along the north wall. Very few sample concentrations exceed a 1 ppm total PCB concentration in the Entrance Channel segment, with a maximum value of 2.636 ppm at WH-SD-040, at an estimated 1 foot depth (Figure 14A).

The sediment thickness in the Outer Harbor ranges from 6 feet to 15 feet (Figure 14B). Very few sample results exceed the 1 ppm total PCB concentration in the Outer Harbor, and those samples with results greater than 1 ppm have a maximum concentration of total PCBs detected of 1.5 ppm at WH-SD-059 (approximate depth of 8 feet).

Figures 15A and 15B depict sediment thickness and total PCB concentrations for sediment in the north-south direction beginning in Slip 4 and ending in the Marina. Sediment thickness in Slip 4 ranges from approximately 7 to 13 feet and there are no total PCB concentration values that exceed 1 ppm. Farther south, in the North Harbor segment (Figure 15A), the sediment thickness decreases to a range between 14 feet and non-measurable. The northernmost portion of the North Harbor appears to have the higher total PCB concentrations, with the highest at sample location WH-SD-003 at an approximate depth of only 2 feet (21.9 ppm).

There is little measurable sediment in the Inner Harbor Extension (Figure 15A) until the southernmost portion along this section, and then only a maximum of 4 feet deep. There is a small zone on the southeastern portion of the extension where sediment thickness measures approximately 14 feet. Neither of the samples have detections above 1 ppm total PCBs in the Inner Harbor Extension (Figure 15A). Farther south, the Inner Harbor has an almost non-measurable thickness along the length of the segment where ship traffic occurs. The sidewalls of the Inner Harbor have up to 10 feet on the northwest wall and up to 14 feet on the southwest wall. The southern portion of the Inner Harbor has up to 11 feet of sediment, and higher concentrations of total PCBs, with the highest (7.47 ppm) at an approximate depth of 6 feet at WH-SD-020. This thicker sediment zone continues into the northern portion of the Marina, where the overall sediment thickness ranges from approximately 5 to 14 feet. The highest concentrations in the Marina are directly adjacent to the Inner Harbor, at WH-SD-022, 19.91 ppm at an approximate 9 foot depth.

Clay Till

Forty-four (44) samples throughout the harbor were comprised of the interval including the top of the clay till beneath softer sediment. Total PCB concentrations for samples collected from till material are presented on Figure 16. Total PCBs were detected in 15 of the 44 till samples, at relatively low concentrations with detections ranging from 0.109 (Outer Harbor) to 0.416 ppm (Inner Harbor Extension). The "detected" range does not include the non-detected or "ND" values on Figure 16. There are non-detectable PCB concentrations (none of the Aroclors were detected) in all of the clay till samples in the Outer Harbor, most of the clay till samples from the Entrance Channel, and most of the clay till samples from the Inner

Harbor Extension and the southern portion of the North Harbor. No PCB Aroclors were detected in either clay till samples from Slip 4. Most of the clay till samples in the North Harbor and the three clay till samples from the Inner Harbor had detections of at least one PCB Aroclor. These results indicate that the harbor clay till is not significantly impacted by PCBs that occur in the unconsolidated sediment.

3.2.2 Asbestos

There is not currently a known, direct discharge of asbestos material to the Waukegan Harbor from an on-land source. Asbestos fibers have been released to Lake Michigan "upstream" of Waukegan Harbor from several potential asbestos sources according to a University of Illinois at Chicago (UIC) report (2005):

- The Johns Manville Superfund site located on Lake Michigan approximately one mile north of Waukegan Harbor
- The remains of residential homes and infrastructure in and around the Illinois Beach State Park (IBSP) just north of Johns Manville.
- Several former rifle range berms reportedly built using Johns-Manville factory waste material donated to the City of Waukegan. The berms were constructed on City land between Johns-Manville property and the (Midwest Generation) power plant property. (Aerial photographs indicate the original location of two of these berms have been eroded into Lake Michigan by natural lake forces).
- Sand dredged from the cooling water channel at the Midwest Generation coal-fired power plant stockpiled on that property—the channel may have intercepted asbestos-containing material (ACM) from other sources and this sand was used for beach nourishment at the IBSP.
- Miscellaneous other local, unconfirmed sources such as a sand stockpile at the Prarie Harbor Yacht Club, transite-like pipe material encountered north of Kenosha Harbor (Wisconsin) and Grant Park Beach in South Milwaukee (Wisconsin).

Fifty-four (54) asbestos samples were collected as part of the GLNPO investigation in 2005 at various depth intervals from 11 locations (WH-SD006, WH-SD008, WH-SD014, WH-SD019, WH-SD027, WH-SD029, WH-SD032, WH-SD037, WH-SD041, WH-SD046, and WH-SD050) within various harbor segments (Figure 3 and Table 5) and submitted for qualitative analysis of asbestos. Based on the qualitative results, 9 of the 54 samples contained "trace" levels of asbestos which is defined as less than 1 percent per examination of properly prepared samples under a stereomicroscope (ProScience Analytical Services, 2005) using polarized light microscopy (PLM) (USACE, 2006) and received further quantitative analyses (Transmission Electron Microscope Method [TEM]). Of the nine samples analyzed quantitatively, only one sample from the Entrance Channel at a depth interval of approximately 2 to 2.5 feet below the top of the sediment surface contained a trace (less than 1 percent) of chrysotile.

USACE conducted an investigation of the Outer Harbor to examine potential re-use options of the dredged material. Although the PCB levels were acceptable for re-use, IEPA expressed concerns about the potential impacts due to asbestos. As such, concerns regarding

the possible inclusion of asbestos fibers in the Outer Harbor sediment required analytical sampling for asbestos and subsequent assessment of asbestos-related risk.

In 2006, USACE collected 12 sediment samples from the Outer Harbor and analyzed them for asbestos using two different methods—polarized light microscopy (PLM) and transmission electron microscopy (TEM) (USACE, 2006). The PLM method examines bulk materials and is therefore limited in identifying small fibers—so the TEM analysis results were used. Of the 12 samples analyzed, 4 contained detectable levels of asbestos fibers ranging from 1 million to 3.9 million fibers per gram of respirable material (i.e., particles smaller than 10 micrometers [µm]).

Sediment samples for asbestos analysis were also collected in 2007 by CH2M HILL on behalf of USEPA from six bulk sediment locations (Figure 3—Area A, B, C, D, E, and F) and seven delineation locations (WH-SD061, WH-SD065, WH-SD067, WH-SD069, WH-SD072, WH-SD073, and WH-SD078) to evaluate full harbor conditions. However, based on the results of the Outer Harbor evaluation, these samples were not analyzed. The 2007 samples were collected from locations farther away from the potential source of the asbestos and should therefore contain lower levels of asbestos concentrations than the Outer Harbor samples. These USEPA samples are currently being stored at OMC Plant 2 for future asbestos analysis, if required.

TABLE 5
Asbestos Sample Summary Table Arranged Farthest Out of Harbor to Farthest Into Harbor

Segment	Date	Field Sample ID	Top of Sample (ft.)	Bottom of Sample (ft.)	"Trace" (<1%) and type of Asbestos detected in Qualitative Testing* (PLM)	Trace and type of Asbestos detected in Quantitative Testing* (TEM)
Outer Harbor						
OH	1/12/2005	WH-SD046-00/12	0.0	1.0		
OH	1/12/2005	WH-SD046-12/24	1.0	2.0		
OH	1/12/2005	WH-SD046-24/30	2.0	2.5		
OH	1/12/2005	WH-SD046-30/38	2.5	4.0		
OH	1/12/2005	WH-SD046-48/72	4.0	6.0		
OH	1/12/2005	WH-SD046-72/96	6.0	8.0	Chrysotile	
OH	1/12/2005	WH-SD046-96/120	8.0	10.0	Chrysotile	
OH	1/12/2005	WH-SD046-120/148	10.0	12.3		
OH	1/12/2005	WH-SD046-148/160	12.3	13.3		
OH	1/11/2005	WH-SD050-00/24	0.0	2.0		
OH	1/11/2005	WH-SD050-24/48	2.0	4.0		
OH	1/11/2005	WH-SD050-48/60	4.0	5.0		
OH	1/11/2005	WH-SD050-60/72	5.0	6.0		
OH	1/11/2005	WH-SD050-72/84	6.0	7.0		
OH	1/11/2005	WH-SD050-84/96	7.0	8.0		
OH	1/11/2005	WH-SD050-120/144	10.0	11.0		
Entrance Channel						
EC	1/11/2005	WH-SD037-00/24	0.0	2.0		
EC	1/11/2005	WH-SD037-24/31	2.0	2.6	Chrysotile, amosite	Chrysotile

TABLE 5
Asbestos Sample Summary Table Arranged Farthest Out of Harbor to Farthest Into Harbor

Segment	Date	Field Sample ID	Top of Sample (ft.)	Bottom of Sample (ft.)	"Trace" (<1%) and type of Asbestos detected in Qualitative Testing* (PLM)	Trace and type of Asbestos detected in Quantitative Testing* (TEM)
EC	1/11/2005	WH-SD037-31/43	2.6	3.6		
EC	1/12/2005	WH-SD041-00/24	0.0	2.0		
EC	1/12/2005	WH-SD041-24/48	2.0	4.0		
EC	1/12/2005	WH-SD041-48/54	4.0	4.6		
EC	1/12/2005	WH-SD041-54/76	4.6	6.6		
EC	1/12/2005	WH-SD041-76/88	6.6	8.5		
Inner Harbor						
IH	1/11/2005	WH-SD019-00/12	0.0	1.0		
IH	1/11/2005	WH-SD019-24/32	2.0	3.0		
IH	1/11/2005	WH-SD029-00/09	0.0	0.5		
Inner Harbor Extension						
IHE	1/11/2005	WH-SD014-00/12	0.0	1.0		
Marina						
Marina	1/12/2005	WH-SD027-00/04	0.0	0.3		
Marina	1/12/2005	WH-SD027-04/10	0.3	0.8		
Marina	1/12/2005	WH-SD027-10/16	0.8	1.3		
Marina	1/12/2005	WH-SD027-16/22	1.3	1.8		
Marina	1/12/2005	WH-SD027-22/28	1.8	2.3		
Marina	1/12/2005	WH-SD027-28/34	2.3	2.8	Chrysotile	
Marina	1/12/2005	WH-SD027-34/40	2.8	3.3		
Marina	1/12/2005	WH-SD027-40/46	3.3	3.8		
Marina	1/12/2005	WH-SD027-46/52	3.8	4.3		
Marina	1/12/2005	WH-SD027-52/58	4.3	4.9		
Marina	1/12/2005	WH-SD027-58/64	4.9	5.4	Chrysotile	
Marina	1/12/2005	WH-SD027-64/70	5.4	6.1		
Marina	1/12/2005	WH-SD027-70/76	6.1	6.6		
Marina	1/12/2005	WH-SD027-76/82	6.6	7.1	Amosite	
Marina	1/12/2005	WH-SD027-82/88	7.1	7.9	Chrysotile	
Marina	1/12/2005	WH-SD032-00/04	0.0	0.3		
Marina	1/12/2005	WH-SD032-04/16	0.3	1.3	Amosite	
Marina	1/12/2005	WH-SD032-16/28	1.3	2.3	Chrysotile	
Marina	1/12/2005	WH-SD032-28/40	2.3	3.3		
Marina	1/12/2005	WH-SD032-40/52	3.3	4.3		
Marina	1/12/2005	WH-SD032-52/64	4.3	5.3		
Marina	1/12/2005	WH-SD032-64/79	5.3	6.7		
North Harbor						
NH	1/11/2005	WH-SD006-00/24	0.0	2.0		
NH	1/11/2005	WH-SD006-24/39	2.0	3.2		
NH	1/11/2005	WH-SD006-39/51	3.2	4.2		
NH	1/11/2005	WH-SD008-00/12	0.0	1.0		

TABLE 5
Asbestos Sample Summary Table Arranged Farthest Out of Harbor to Farthest Into Harbor

Segment	Date	Field Sample ID	Top of Sample (ft.)	Bottom of Sample (ft.)	"Trace" (<1%) and type of Asbestos detected in Qualitative Testing* (PLM)	Trace and type of Asbestos detected in Quantitative Testing* (TEM)

Notes: *The EPA recognizes asbestos types as actinolite, amostie, anthophylite, chrysotile, crocidolite, and tremolite.
To be "asbestos containing," a material must be determined to contain greater than one percent asbestos (ProScience, 2005)
PLM = polarized light microscopy
TEM = transmission electron microscopy

3.2.3 Fish Tissue

PCBs are one of the contaminants of greatest concern in fish in Lake Michigan. The FDA action levels for PCBs (2 ppm) in fish were regularly exceeded in samples collected from Illinois Lake Michigan fish. This led to the posting of signs warning that fish from the Waukegan North Harbor are not to be consumed. Recent monitoring data indicate, however, that contaminant concentrations in fish tissue continue to decrease. Warning signs from within the harbor were removed sometime prior to 2000 because sampling had shown declines in concentrations to the same level as the greater Lake Michigan area (USEPA, 2000a).

Carp have been selected as the target species for monitoring fish flesh contaminant levels for Waukegan Harbor, since they are bottom feeders that are active within the harbor. Significant reductions of PCBs have been observed in carp since the 1992 harbor dredging was completed (from 19 ppm in 1991 to an average of about 3 ppm in 1993). Although the average PCB levels in carp have fallen to less than half of the level found prior to dredging, averages among all samples have increased somewhat in recent years. Average PCB levels among all size groups were 4.17 ppm in 1996, 5.04 ppm in 1997, and 6.77 ppm in 1998.

In 1999 and early 2000, however, two individual fish tissue samples from Waukegan Harbor showed uncharacteristically high levels of PCBs. This prompted additional sampling using carp as the target species. In September and October 2000, 19 carp samples were tested from Waukegan Harbor. Results showed that PCB concentrations are consistent with fish samples collected by other Lake Michigan states. In the carp samples, total PCB values ranged from less than 1 to 7.2 ppm, with a mean of 3.2 ppm. The historical data for Waukegan Harbor carp tested since 1993 includes 57 samples averaging 5.2 ppm PCBs. The Lake Michigan Fish Consumption Advisory issued by Illinois now warns the public not to eat carp from Lake Michigan waters of Illinois (USEPA, 2003).

Concentrations of PCBs in fish tissue for this report were provided by IEPA, and are from fish collected during the Illinois Fish Contaminant Monitoring Program (CH2M HILL, 2006). The Illinois Fish Contaminant Monitoring Program screens fish samples from about 40 bodies of water per year for contamination from 13 banned pesticides and industrial chemicals. The program is a joint effort of the IEPA and the Departments of Agriculture, Natural Resources, and Public Health. The fish are collected by the Illinois Department of Natural Resources (IDNR) and tested by IEPA. The Illinois Department of Public Health (IDPH) bases its

consumption advisories on the IEPA test results. Fish samples have been collected from Waukegan Harbor (Station Code QZO-01) on an annual basis under this program since 1996 (with the exception of 2002). The fish tissue data used in the RI Report and risk evaluation are presented in Table 6. The IEPA provided the fish tissue data in an electronic format without sampling method and quality assurance/quality control (QA/QC) information, so inferences regarding the data quality could not be reviewed. The average PCB concentration in all fish from the 2001 to 2005 data set (24 samples) was 2.62 ppm and from the 2003 to 2005 data set (12 samples) was 0.57 ppm.

TABLE 6
Summary of PCB Concentrations in Fish Fillet Samples

	All Fish		Gamefish only		Bottomfish only			
Fish Tissue Data Set	**Average PCB Concentration (mg/kg-wet)**	**Number of Samples**	**Average PCB Concentration (mg/kg-wet)**	**Number of Samples**	**Average PCB Concentration (mg/kg-wet)**	**Number of Samples**	**Fish PCB Concentration for Recreational Angler (mg/kg-wet)[a]**	**Fish PCB Concentration for High-End Consumer (mg/kg-wet)[b]**
2001-2005 Data Set	2.62	24	0.30	6	3.40	18	0.30	1.08
2003-2005 Data Set	0.57	12	0.30	6	0.84	6	0.30	0.44

[a.] Concentration for the recreational angler scenario assumes that fish in the diet are comprised of gamefish only.

[b.] Concentration for the high-end consumer scenario assumes that fish in the diet are comprised of 25 percent bottomfish and 75 percent gamefish.

SECTION 4

Fate and Transport

PCBs do not appreciably degrade or attenuate, but do bioaccumulate into harbor fish. PCBs strongly adsorb to soil/sediment particles, have low water solubility, are persistent in the environment (do not readily break down), and thus do not migrate significantly beyond the particles they are adhered to, nor do they significantly degrade.

Five separate PCB compounds have been detected in historical and recent data within Waukegan Harbor sediments: 1221, 1242, 1248, 1254, and 1260. The potential degradation, release, or transport mechanisms are discussed in this section. However, it should be noted that the mechanisms are insignificant except for the movement of PCBs along with sediments to which the PCBs are sorbed. The fate and transport properties of PCBs were evaluated to assess the potential for these contaminants to move from their current location within the sediments of Waukegan Harbor.

The transport and fate of contaminants depends on the physical and chemical properties of the compounds, the biological and chemical processes affecting them, and the media through which they are migrating. Specifically, this section describes the following:

- Physical, chemical, and migration properties of PCBs
- Potential migration pathways
- Migration and fate of representative compounds

4.1 Physical and Chemical Properties

The mobility and persistence of PCBs are determined by their physical and chemical interaction with the environment. Mobility is the measure of a chemical's movement from its current position. The important properties relative to contaminant mobility include molecular weight, water solubility, specific gravity, vapor pressure, Henry's law constant, and partitioning coefficients. Typical values for these properties for the different PCB Aroclors are provided in Table 7.

Environmental factors that affect the behavior of a chemical include soil or water pH, concentration of other ions in the medium, moisture content, oxidation-reduction potential, organic content, and the presence of macro- and microorganisms.

PCBs are a class of chlorinated chemical compounds in which 2 to 10 chlorine atoms are attached to the biphenyl molecule (two connected benzene rings). There are 209 related substances (congeners) that are classified as PCBs. Mixtures of PCB congeners were sold under the trade name Aroclor. The Aroclors are identified by a four-digit numbering code in which the first two digits indicate the type of mixture (the number of carbons in the structure) and the last two indicate the approximate chlorine content by weight percent.

TABLE 7
Chemical and Physical Properties of Some PCB Aroclors

Aroclor	Avg. Formula Weight (g/mole)	Density	Water Solubility[a] (mg/L)	Vapor Pressure[b] (mm Hg)	Log K_{ow}	K_{oc}[c] (mL/g)	Henry's Law Constant[d] (atm-m^3/mol)
1016*	257.9	1.37	0.42	4×10^{-4}	5.6	5.4×10^{4}	2.9×10^{-4}
1221	200.7	1.18	0.59 at 24°C	6.7×10^{-3}	4.7	2.8×10^{2}	3.5×10^{-3}
1232*	232.2	1.26	0.45	4.06×10^{-3}	5.1	6.8×10^{2}	8.6×10^{-4} [c]
1242	266.5	1.38	0.34	4.06×10^{-4}	5.6	5.1×10^{3}	5.2×10^{-4}
1248[c]	261	1.41	0.060 at 24°C	4.94×10^{-4}	6.1	4.4×10^{5}	5.6×10^{-4}
1254	328	1.54	0.057 at 24°C	7.71×10^{-5}	6.5	4.1×10^{5}	2.0×10^{-3}
1260	357.7	1.62	0.08 at 24°C	4.05×10^{-5}	5.8	2.6×10^{6}	4.6×10^{-3}
1262*	389	1.64	0.052 at 24°C	No data	No data	No data	No data
1268*	453	1.81	0.3 at 24°C	No data	No data	No data	No data

Note:
All data were obtained from ATSDR's *Toxicological profile for Polychlorinated Biphenyls (PCBs)* (November 2000), unless otherwise indicated.
[a]Water Solubility in mg/L at 25°C, unless specified
[b]Vapor Pressure in mm Hg at 25°C
[c]Data from *Groundwater Chemicals Desk Reference* (Montgomery and Welkom, 1989)
[d]Henry's Law constant measured at 25°C

*This Aroclor not detected in Waukegan Harbor Sediment but properties are included for additional information.

Mobility and Partitioning

PCBs have low vapor pressures, low water solubility, and high partitioning coefficients (K_{ow}). PCBs are relatively insoluble in water, and the solubility decreases with increased chlorination. PCBs are freely soluble in polar organic solvents and biological lipids. Aroclor mixtures with between 40 and 60 percent chlorine have reported solubility in water of 0.06 to 0.34 milligrams per liter (mg/L) (Table 7).

PCBs in sediment are unlikely to leach to underlying clay till because of low water solubility and strong binding potential to the solid matrix. Once bound, the PCBs can be immobilized for relatively long periods with slow desorption that provides continuous, extremely low-level exposure to the surrounding locality. The adsorption of PCBs onto solids is greatest for solids composed primarily of organic matter. Although some organic matter is present in Waukegan Harbor sediment, the amount only ranges from 1.4 to 5.8 percent TOC. The more highly chlorinated PCBs are less soluble in water, have higher distribution coefficients (K_ds), and a greater tendency to bind to solids (i.e., sediments) as a result of strong hydrophobic interactions. In contrast, the low molecular weight PCBs, which have a higher water solubility and lower K_ds, sorb to a lesser extent on solids and are more likely to remain in the water or to volatilize (see Table 7). PCBs also leave the water column by concentrating in biota.

PCBs may be transported from sediment to the atmosphere as PCB-impacted sediment is exposed to the atmosphere during the remedial activities (such as dredging), but this

amount is expected to be negligible. If PCBs dissolve into the water column, they are available for volatilization into the atmosphere—again, a negligible affect is expected for this mechanism.

Persistence and Degradation

The chemical, physical, and biological properties of PCBs depend to a large degree on the amount and location of the chlorine atoms on the two benzene rings of each specific PCB and on the particular mixture of individual chlorobiphenyls that comprise the mixture. In general, the more chlorine present in a PCB, the longer it will take to degrade and the more potential harm it may cause to organisms (Mackay, et. al, 1992). PCBs with fewer chlorine atoms are more soluble, more amenable to chemical and biological degradation, and less persistent in the environment than those PCBs with more chlorine atoms.

The vapor-phase reaction of PCBs with hydroxyl radicals is the dominant transformation process in the atmosphere. In water, abiotic transformation processes such as hydrolysis and oxidation do not significantly degrade PCBs. Photolysis appears to be the only significant chemical degradation process in water. Photolysis of PCBs occurs by photolytic cleavage of a carbon-chlorine bond followed by a stepwise replacement of chlorine with hydrogen which degrades PCBs. In all cases, the ring with the greatest degree of chlorination is the primary ring where dechlorination occurs. Photolysis of PCBs from surface soil may occur and PCBs may also undergo base-catalyzed dechlorination, but neither process is likely to be a significant removal mechanism. There is no known abiotic process that significantly degrades PCBs in soil and sediment (Agency for Toxicity Substances and Disease Registry [ATSDR], 2000).

Anaerobic microbial degradation in sediments will be primarily responsible for transformation, particularly of the more highly chlorinated congeners. PCBs biodegrade very slowly in anaerobic environments through reductive dechlorination, resulting in the formation of less toxic mono- and dichlorobiphenyl congeners that are aerobically biodegradable. For reductive dechlorination to occur, a low redox potential similar to methanogenesis and the absence of oxygen are thought to be required, although some studies have shown that sulfidogenic conditions may also allow reductive dechlorination to proceed but at a comparatively slower rate. Optimal rates of PCB dechlorination usually occur in the concentration range of 100 to 1,000 ppm (wet weight). Below a concentration of approximately 50 ppm (a similar concentration range to that encountered in Waukegan Harbor sediment), the rate of dechlorination is often very slow or nonquantifiable. PCBs generally remain tightly bound in soil and sediment, and may not be bioavailable to the biodegrading organisms even at optimum concentration. Some studies report that dechlorination was shown under denitrifying and iron (III) reducing conditions. Rates of dechlorination are fastest in methanogenic (the most reducing) environments (ATSDR, 2000).

4.2 Potential Migration Pathways

4.2.1 Source Area

The source area for the PCBs in Waukegan Harbor is the sediment at varying concentrations across nearly the entire harbor. The PCB contamination can potentially move with the

sediment and disperse farther into the environment. The maximum PCB sediment concentrations were detected in the vicinity of the North Harbor, Inner Harbor, and Marina (Figure 11), with the highest PCB concentration of 36.64 at Sample WH-SD027 collected at the Marina.

4.2.2 Release and Transport Mechanisms

Potential routes of migration for the contamination exist where chemicals can be released to the environment from the sediment. The possible contaminant release and transport mechanisms and pathways from the sediment are shown conceptually in Figure 17 and include the following:

- Movement of contaminated sediment via littoral processes or the re-suspension and transport of sediment by prop wash from commercial vessels.
- Desorption/dissolution of the PCB contamination from the sediment by harbor water. Dissolved concentrations of PCBs would then move with water processes in the harbor and in Lake Michigan and/or volatilize into the atmosphere.
- PCBs may leave the water column (once dissolved) by partitioning onto solids (soil, sediments, and suspended particulates), by consumption from biota, and by volatilization at the air/water interface.

Adsorption plays a significant role in the migration of PCBs. The adsorption and transport is controlled by both the physical characteristics of the sediment and properties of the PCBs. The two main properties that will affect the transport of contaminants from or with the sediment include the following:

- **Organic carbon partitioning coefficient of the contaminant (K_{oc})**—The K_{oc} for Aroclor 1248 is 440,000 milliliters per gram (mL/g). The higher the K_{oc}, the more likely a chemical is to bind to the solid matrix than to remain in water. K_{oc} values greater than 2,000 mL/g are generally reflective of relatively immobile constituents.
- **Organic carbon content of the Sediment**—Harbor sediment with higher TOC measurements ranged from 1.4 percent to 5.8 percent as shown on Figure 7. The harbor segment with the highest amount of organic carbon is the northern portion of the North Harbor—Slip 1, and the southern portion of the Inner Harbor also has relatively higher amounts of TOC, indicative of areas where PCB contamination would have a relatively higher affinity for remaining sorbed to sediment particles.

The vast majority of the PCBs is adsorbed onto sediments and will move primarily with the sediments they are sorbed to—the amount of movement will depend on the location within the Harbor. Sediment movement within and/or out of Slip 4, North Harbor, and the Marina is expected to be minimal—the only re-suspension of sediment in these segments would be due to recreational marine traffic, so the sediment in these segments is expected to remain mostly in place. More transport within the harbor is expected in the navigational segments due to re-suspension of shallow sediment from propeller wash by deep-draft commercial vessels. The shallow sediments in the harbor segments near the entrance (Entrance Channel and Outer Harbor) are also influenced by wind-induced seiches and waves entering the harbor.

4.2.3 Fate and Transport Summary

PCBs do not appreciably degrade or attenuate, but do bioaccumulate into harbor fish. PCBs strongly adsorb to soil/sediment particles, have low water solubility, are persistent in the environment (do not readily break down), and thus do not migrate significantly beyond the particles they are adhered to, nor do they significantly degrade.

Therefore, the primary mechanism of transport of PCB contamination sorbed to harbor sediment is movement of the PCBs with the sediment particles. All other degradation, release, or transport mechanisms are assumed to be negligible.

SECTION 5

Human Health and Ecological Risk Assessment

5.1 Human Health Risk Evaluation

In addition to PCBs, other chemicals such as PAHs and arsenic were detected in the harbor sediments at low concentrations. Unlike PCBs, these chemicals will not bioaccumulate appreciably in fish and would not cause significant health risks to persons swimming or having direct contact with sediments. These chemicals do not readily penetrate the skin and even ingestion of small amounts of water by swimming would not yield appreciable risk.

PCBs do not appreciably degrade or easily attenuate, but bioaccumulate into harbor fish. Other risk assessments (Fox River and Green Bay RI/FS) have found that swimming in the harbor or direct contact with sediments containing PCBs would not yield significant health risks from PCBs (Clark, 2003). Therefore, the evaluation of risk from exposure to PCBs in sediment focuses on the ingestion of fish caught from Waukegan Harbor.

5.1.1 2003 Risk Evaluation

In July 2003, USEPA evaluated the short- and long-term risks associated with PCB contamination existing in Waukegan Harbor sediments (Clark, 2003). Based on the PCB concentrations in sediment and fish, USEPA determined that the current levels of PCBs in Waukegan Harbor sediments pose cancer and non-cancer risks above USEPA and IEPA criteria. Since PCBs do not appreciably degrade or attenuate and have remained bioavailable in this harbor, action was recommended by USEPA to reduce environmental risks associated with exposure to PCB-contaminated harbor sediments.

The USACE data used in the 2003 risk evaluation indicated that the average PCB level in the harbor area sediments was about 2.5 ppm, with a few discrete sediment samples several times higher than the overall average. Carp fillets taken from Waukegan Harbor in 2000 and 2001 averaged 4.5 and 3.8 ppm PCB, respectively, exceeding the State of Illinois' (State's) do-not-eat criteria of 1.9 ppm. PCB concentrations in other fish, such as rock bass (estimated to be 0.5 ppm for fillets) also exceeded the State's safe level for fish of 0.05 ppm PCB. USEPA concluded that in order to reduce PCBs to acceptable levels in fish, PCB levels in sediments would need to be lowered five-fold to reach a cancer risk level of 1 in 10,000 (level for fish advisories) and about ten-fold to achieve an acceptable noncancer risk.

An overall surface weighted average concentration (SWAC) of 0.25 ppm PCB was calculated in 2003 to properly protect public health. The risk evaluation also noted that RODs prepared by USEPA during that general time period specified a sediment remediation level of 1 ppm to achieve a SWAC of 0.25 ppm PCBs to protect public health from PCBs in fish (Clark, 2003). Based on this information, action to achieve a resultant SWAC in the range of 0.25 ppm PCB in sediments was recommended by USEPA in 2003 (Clark, 2003).

5.1.2 2006 Risk Evaluation

In 2006, a risk evaluation was performed to verify and document that the recommended 2003 PCB cleanup concentration for sediment (i.e., SWAC of 0.25 mg/kg) would be adequate to protect potentially exposed populations that consume fish from Waukegan Harbor (CH2M HILL, 2006). The procedures and assumptions used in the evaluation were in accordance with the understanding reached at a risk assessment meeting between USEPA and IEPA on April 28, 2006. Fish tissue results collected during 2001 to 2005 from IEPA and total PCB data from USEPA's 2003 and 2005 investigations were used to establish an empirical relationship between the PCB concentrations in sediment and those in fish tissue. Risk-based sediment cleanup levels were then calculated corresponding to various fish consumption rates. Sediment risk-based concentrations (RBCs) for the recreational angler and high-consumption consumer scenarios indicate that none of the estimated RBC_{sed} values for non-carcinogenic endpoints (HQ=1) are below the proposed sediment cleanup goal of a SWAC of 0.25 mg/kg PCBs, with one exception. Under the high-consumption scenario, an RBC_{sed} of 0.2 was calculated for the unrestricted consumption category (225 meals per year). However, this is based on the 2001 to 2005 fish tissue dataset, and the corresponding RBC_{sed} value for the 2003 to 2005 dataset (0.49 mg/kg) is above 0.25 mg/kg. Using the 2003 to 2005 dataset, a SWAC of 0.25 mg/kg PCBs corresponds to an estimated HQ ranging from 0.1 (central tendency estimate [CTE] case) to 0.3 (reasonable maximum exposure [RME] case) for the high-consumption consumer scenario.

For the cancer endpoint, the proposed sediment cleanup goal of a SWAC of 0.25 mg/kg PCBs corresponds to a cancer risk well within the $1x10^{-6}$ to $1x10^{-4}$ risk range that USEPA generally uses to make risk-management decisions, for both the CTE and RME cases. For the consumption rates corresponding to the four fish advisory groupings currently used by IEPA, the calculated RBC_{sed} values correspond to a cancer risk between $1x10^{-5}$ to $1x10^{-4}$ for both the 52 meals per year case (using the 2001 to 2005 fish tissue dataset only) and the unrestricted 225 meals per year case (using both fish tissue datasets). Using the 2003 to 2005 dataset, a SWAC of 0.25 mg/kg PCBs corresponds to an estimated risk ranging from $2x10^{-6}$ (CTE case) to $9x10^{-6}$ (RME case) for the high consumption consumer scenario. These results indicate that, based on the 2001 to 2005 fish tissue data set, a sediment cleanup goal of a SWAC of 0.2 mg/kg total PCBs is protective of high-consumption consumers of fish from the harbor.

5.1.3 Fish Advisories

In the past, fishing advisories were posted at the Waukegan Harbor (based on PCB data from fish sampling), and post-remediation (after 1993) monitoring data indicated contaminant concentrations in fish had decreased (USEPA, 2000a). Results for carp in 2000 showed PCB concentrations consistent with fish samples collected by other Lake Michigan states and the public was warned not to eat carp from Lake Michigan waters of Illinois (USEPA, 2003).

In February 2006, IDPH issued a state-wide sports fish consumption advisory for Illinois waters that included the "Waukegan North Harbor of Lake Michigan." IDPH recommended that meals of white sucker and sunfish taken from the harbor be limited to one per month due to the elevated levels of PCBs in fish. All other species caught in the harbor should

follow the advisory for Lake Michigan fish concerning PCB and methylmercury levels (USEPA, 2007).

5.1.4 Asbestos

USACE conducted an investigation of the Outer Harbor to examine potential re-use options of the dredged material. Although the PCB levels were acceptable for re-use, IEPA expressed concerns about the potential impacts due to asbestos. In 2006, USACE collected and analyzed 12 sediment samples from the Outer Harbor segment using TEM (USACE, 2006) and assessed the potential risk to human health based on the amount of asbestos detected.

Of the 12 samples analyzed, 4 contained detectable levels of asbestos fibers ranging from 1 million to 3.9 million fibers per gram of respirable material (i.e., particles smaller than 10 μm). The amount of respirable dust that would become airborne was also estimated for inhalation, and applied to an asbestos value of 95 percent of the upper confidence limit (UCL) in a toxicity assessment. The incremental cancer risk was calculated to be $4x10^{-8}$ using the estimated amount of respirable dust and the 95 percent UCL of asbestos concentration. This equates to four excess cancers within a population of 100 million and is incremental to the background rate (within the American population) of contracting cancer, which is currently slightly greater than 33 cancers within a population of 100 Americans (American Cancer Society, 2006). The USACE risk assessment concluded that Outer Harbor sediment could be re-used on land without further consideration of risk from asbestos.

The suspected sources for the asbestos to the Outer Harbor sediment is via transport by littoral currents from numerous potential sources at least a mile north upstream of the Waukegan Harbor (UIC, 2005). There are currently no known, direct sources of asbestos into Waukegan Harbor. The sediments in the interior harbor segments are anticipated to have lower concentrations of asbestos than Outer Harbor samples since they are even farther away from asbestos source, and should therefore not require further risk evaluation.

5.2 Ecological Assessment

5.2.1 Harbor Habitat and Species

As discussed in Section 2, in addition to Waukegan Harbor, the most significant ecological features in the area include Lake Michigan and its shoreline, including the beach and dune areas east of the harbor. Adjacent to the harbor, terrestrial habitat exists but is limited to maintained/mowed grassy areas (e.g., the WCP site, the former Slip 3 containment cell, and the Warren Siver Park), gravel areas, and paved parking lots. Wetland areas do not occur immediately adjacent to the harbor. Ecological assessments related to the beach area east of the WCP site and the dune and beach areas east of the OMC Plant 2 site can be found in their respective RI reports.

Lake Michigan provides a diverse aquatic habitat and supports a commercial and sport fishery. Waukegan Harbor, a developed embayment of Lake Michigan, is located west and south of the Waukegan Beach area. Factors that limit Waukegan Harbor's value as a habitat include regular industrial boat traffic that stirs up and muddies the harbor waters, dredging

operations that disturb harbor sediments and affect surface water quality, and the lack of cover caused by the deep, vertical harbor walls (CH2M HILL, 1995).

Fish and macroinvertebrates reside in harbor waters and have limited or nonexistent mobility, indicating these species are likely to spend a major portion of their entire life cycle within the study area. In addition, these organisms live in direct contact with the surface water or sediment in the harbor, increasing the probability that they will come in contact with contaminants in those media. Yellow perch and bloaters are harvested commercially. The Lake Michigan sport-fishing catch consists primarily of yellow perch, chinook and coho salmon, and steelhead, brown, and lake trout. Two state-threatened fish species, the longnose sucker and the lake whitefish, have been reported in Lake Michigan between Zion and Waukegan. The last sightings of these species were in 1985 for the longnose sucker and in 1991 for the lake whitefish (CH2M HILL, 1995).

5.2.2 Sediment Toxicity to Organisms

A sediment toxicity study for Waukegan Harbor was completed by USEPA in 1999, representing post-1992 remediation activities where Slip 3 isolation and dredging of the North Harbor were accomplished (see Sections 1.3, and 1.4, above). In general, these test results are applicable to current conditions as additional dredging activities have not been conducted and PCBs do not appreciably degrade or easily attenuate. Two approaches were used to assess sediment toxicity (USEPA, 1999b):

1. Whole-sediment toxicity tests with the amphipod (crustacean) *Hyalella azteca*,
2. Solid-phase sediment tests and basic toxicity tests with Microtox®

Sediment samples used from Waukegan Harbor for this study were generally not lethal to amphipods—only 6 of the 20 sediment samples were toxic. However, amphipod growth was significantly reduced in all of the sediment samples compared to the control sediment after both 28 and 42 day time periods. The Microtox test identified all of the sediment sites except one in which amphipod survival was significantly reduced compared to the control samples at Day 28. The available guidelines during the study for evaluation of Great Lakes harbor sediment classified sediment samples as moderately toxic if total PCB concentrations range from 1 to 10 micrograms per gram (µg/g) (ppb). Based on the criteria, 18 of 19 sediment samples used in this study would be classified as moderately toxic based on their total PCB concentrations (USEPA, 1999b).

SECTION 6

Summary and Conclusions

In 2002, USEPA performed a technical assessment to determine whether the remedy implemented in 1992 remains protective of human health and the environment. USEPA determined that the 50 ppm cleanup level for PCBs (set forth in the 1984 ROD) in harbor sediments may not be protective, based on PCB levels in harbor-caught fish were still above action levels and the PCB remediation levels at other sediment sites were being set as low as 0.25 to 1.0 ppm. USEPA indicated that investigations were needed to determine the extent of PCB contamination remaining in the harbor and to evaluate impacts of PCB levels in sediment on PCB levels in the fish (USEPA, 2002). This RI integrates the post-remediation data (post-1992) and data from recent USEPA investigations to define the nature and extent of PCB concentrations in the Waukegan Harbor sediment. The results will be used in a feasibility study to develop potential remedial alternatives and to support anticipated future harbor cleanup decisions.

The USEPA investigations have included collection and laboratory analysis of sediment core and bulk samples, sediment delineation via mapping of sediment thickness and soil type, and collection and laboratory analysis of harbor water samples, both undisturbed and disturbed by shipping traffic.

6.1 Physical Site Characteristics

Waukegan Harbor is an active harbor that currently supports recreational and commercial shipping. The harbor is a largely man-made structure that comprises 35 to 40 acres, with water depths varying from 8 to 24 feet. Nearly the entire harbor is bordered by steel sheet piling except for in the Marina and along both of the north and south piers. The harbor has no tributary flow.

The generalized stratigraphy of the sediments in Waukegan Harbor includes the following (from upper layer to the lower layer):

- Soft, organic silt and/or clay with relatively high organic contents and moisture contents throughout the harbor, except in the Inner Harbor Extension and the Outer Harbor areas. This material ranges in thickness from about 0.5 foot to 10.5 feet.
- Loose to moderately dense, medium-grained sand with some silt and clay with approximately half the amount of organic and moisture contents as measured in the overlying or underlying silts and clays.
- Very stiff, firm, silty clay till with trace sand, low plasticity, and relatively low moisture content encountered beneath softer sediment at depths ranging from -12 to -29 feet LWD. Trace amounts of fine to coarse sand and shale and an apparent unconfined compressive strength of 4.5 tons per square foot or greater.

The total volume of sediment within Waukegan Harbor, including the Outer Harbor, Entrance Channel, Inner Harbor, Inner Harbor Extension, Marina, Slip 1, North Harbor, and Slip 4 is estimated to be approximately 578,000 yd^3. Sediment in the Outer Harbor comprises approximately 38 percent of all harbor sediment, and the majority of the Outer Harbor sediment is comprised of coarse material—sand or gravel in size.

Lake Michigan influences Waukegan Harbor in several ways. Most significantly, the nearly continual exchange of water between the lake and harbor, caused predominantly by wind-induced seiches, prevents total stagnation of the harbor water. The lake also causes mixing in the harbor by direct waves entering the harbor through the Entrance Channel. In addition, large ships and tug boats re-suspend large amounts of sediment as a result of the use of the propellers and bow-thrusters to maneuver within the narrow navigational channel.

6.2 Nature and Extent of Contamination

The remediation project conducted by OMC in 1992 included the removal or plugging of pipes that discharged PCBs into Waukegan Harbor (via the Slip 3 outfall). Other surface drainage systems were removed, covered, or filled in as a result of the OMC cleanup action and no longer exist. There are currently no additional known sources contributing PCBs to the harbor.

6.2.1 Harbor Water

Historical sample results for the harbor indicated water quality conditions were worse in the innermost reaches of the harbor and improved toward the harbor mouth. Ammonia, cyanide, phenols, and dissolved oxygen were at concentrations causing the most concern. GLNPO collected water samples from the harbor in 2007 to determine the effects of ship propellers on re-suspending sediment and the resulting water column contaminant concentrations. The analytical result for the baseline sample (collected prior to shipping activity) included detections of phosphorus, total ammonia nitrogen, hardness, total organic carbon, total suspended solids (TSS), total volatile solids, arsenic, copper, and mercury. Total PCBs were not detected in this baseline sample. Mercury was the only constituent in the baseline sample with a concentration (1.4 nanograms per liter [ng/L]) that exceeds its criteria based on the Illinois Water Quality Standards (1.3 ng/L).

6.2.2 Sediment

PCBs

Of the five separate PCB compounds (Aroclors 1221, 1242, 1248, 1254, and 1260) that have been detected in historical and recent data within Waukegan Harbor sediments, Aroclor 1248 was the most frequently detected and at the highest concentrations. The maximum PCB concentrations in sediment were detected in the vicinity of the North Harbor, Inner Harbor, and Marina, with the highest PCB concentration of 36.64 from a sample collected in the Marina. In general, the highest PCB concentrations occur at depths of less than 3 feet.

The findings relative to the nature and extent of PCB-impacted sediment in the various harbor segments include the following:

- **Slip 4**—Sediment thickness is consistent within the slip, ranging between 7 and 13 feet. The average concentration of total PCBs in the Slip 4 sediments is 0.21 ppm, with overall low concentrations ranging between 0.24 and 0.45 ppm at locations where at least one Aroclor was detected.

- **North Harbor**—The sediment in the North Harbor ranges from non-measurable to a thickness of approximately 14 feet with total PCB concentrations exceeding 20 ppm in at least three locations. The average total PCB concentration in this segment is 4.9 ppm with concentrations ranging from 0.12 to 26.9 ppm at locations where at least one Aroclor was detected. The sediment from northernmost portion of the North Harbor (i.e., closer to the former source) contains the highest concentrations.

- **Inner Harbor Extension**—Sediment thickness in this segment ranges from non-measurable to 9 feet with a small zone in the south that is 14 feet thick. The average total PCB concentration is 1.8 ppm with concentrations ranging from 0.14 to 9.3 ppm at locations where at least one Aroclor was detected.

- **Inner Harbor**—The main shipping channel of the Inner Harbor has almost no measurable thickness of sediment. The sediment along the northwestern and southwestern sidewalls was measured to be up to 10 and 14 feet, respectively. The southern portion of the Inner Harbor has up to 11 feet of sediment. Higher concentrations (up to 7.47 ppm) of total PCBs in sediments were detected at depths of about 6 feet. The entire sediment column in the western portion of the Inner Harbor (contiguous with the Marina) was found to be contaminated with total PCB concentrations ranging from 1.7 to 9.6 ppm. The average total PCB concentration of the entire Inner Harbor segment is 4.0 ppm, with a concentration range of 0.13 to 32.3 ppm at locations where at least one Aroclor was detected.

- **Slip 1**—The sediment thickness in Slip 1 ranges from less than one-tenth of a foot where boat traffic is centered to almost 13 feet near the seawalls. The total PCB concentrations range from 0.51 to 16.7 ppm at locations where at least one Aroclor was detected, with the highest concentration occurring in the northern portion. The average total PCB concentration in Slip 1 is 4.6 ppm.

- **Marina**—Sediment thickness in the Marina ranges between 2 and 14 feet. The Marina contains the sediment deposit with the most consistent, higher total PCB concentrations as indicated on the cross sections (Figures 14A through 15B). Consistent total PCB concentrations exist throughout the sediment column in the northernmost portion of the Marina. The average total PCB concentration in the Marina is 3.4 ppm with a concentration range of 0.10 to 36.6 ppm at locations where at least one Aroclor was detected.

- **Entrance Channel**—The Entrance Channel sediment thickness varies from approximately 2 to 8 feet along its length and up to 15 feet along the northern wall. The average total PCB concentration is 1.0 ppm with a concentration range of 0.079 to 8.4 ppm total PCBs at locations where at least one Aroclor was detected.

- **Outer Harbor**—The Outer Harbor has a sediment thickness range of between 6 and 15 feet. The average total PCB concentration for samples in this segment is 0.23 ppm

with concentrations ranging between 0.11 and 1.5 ppm total PCBs at locations where at least one Aroclor was detected.

Asbestos

The potential presence of asbestos in harbor sediment was evaluated due to numerous possible potential asbestos sources located at least a mile "upstream" from the harbor in Lake Michigan (UIC, 2005). A total of 54 asbestos samples were collected by USEPA in 2005 at various depth intervals from 11 locations and from various harbor segments and submitted for qualitative analysis of asbestos. Based on the qualitative results, the laboratory was directed to initiate quantitative analyses on the nine samples containing trace levels (less than 1 percent) of asbestos. Of the nine samples analyzed quantitatively, only one sample from the Entrance Channel segment (approximately 2 to 2.5 feet below the top of the sediment surface) contained a trace of chrysotile.

In 2006, USACE collected 12 sediment samples from the Outer Harbor segment and analyzed them for asbestos using two different methods. Of the 12 samples analyzed, 4 contained detectable levels of asbestos fibers ranging from 1 million to 3.9 million fibers per gram of respirable material (i.e., particles smaller than 10 μm). The USACE concluded that concentrations detected were determined to cause no increased cancer risk (USACE, 2006).

6.2.3 Clay Till

Forty-four (44) samples throughout the harbor were comprised of the interval including the top of the clay till beneath softer sediment. PCBs were detected in 15 of the 44 clay till samples, with total detected PCB concentrations ranging from 0.109 to 0.416 ppm at locations where at least one Aroclor was detected. There were no PCBs detected in Outer Harbor or Slip 4 clay till samples. The results indicate that the till is not significantly impacted by PCBs that occur in the unconsolidated sediment.

6.2.4 Fish Tissue

Fish samples have been collected from Waukegan Harbor (Station Code QZO-01) on an annual basis by IEPA since 1996 (with the exception of 2002). The average PCB concentration in all fish from the 2001 to 2005 data set (24 samples) was 2.62 mg/kg and from the 2003 to 2005 data set (12 samples) was 0.57 mg/kg, supporting an overall trend of decreasing PCB concentration in fish tissue.

6.3 PCB Fate and Transport

PCBs strongly adsorb to soil particles, have low water solubility, are persistent in the environment (do not readily break down), and thus do not show much migration in a given environment. Once bound, the PCBs can be immobilized for relatively long periods with slow desorption providing continuous low-level exposure to the surrounding locality. The adsorption of PCBs onto solids is greatest for solids composed primarily of organic matter and clay, similar to the surficial soft material encountered in portions of Waukegan Harbor.

Adsorbed PCBs will move primarily with the sediments they are sorbed to—the amount of movement will depend on the location within the harbor. Sediment movement within and/or out of Slip 4, northern end of the North Harbor, and the Marina is expected to be

minimal—the only resuspension of sediment within these segments would be due to recreational marine traffic. The sediment in these segments is expected to remain mostly in place. More sediment re-suspension and transport would be expected in Slip 1 and the navigational segments of the harbor due to propeller wash by the deep draft commercial vessels. The shallow sediments in the harbor segments near the harbor entrance (Entrance Channel and Outer Harbor) are also influenced by wind-induced seiches and waves entering the harbor. PCB concentrations on sediment could de-sorb/dissolve into the water column, although this is expected to occur on a relatively minor basis. Similarly, the small amount of PCB contamination that may be dissolved in the water column may have minor amounts of volatilization into the air above the water surface.

6.4 Human Health Risk Evaluation

6.4.1 PCBs in Sediment

PCBs do not appreciably degrade or easily attenuate, but bioaccumulate into harbor fish that may be eaten by humans. In July 2003, USEPA evaluated the short- and long-term risks associated with PCB contamination existing in Waukegan Harbor sediments (Clark, 2003). Carp fillets taken from Waukegan Harbor in 2000 and 2001 averaged, 4.5 and 3.8 ppm PCB, respectively, exceeding the State of Illinois' (State's) do-not-eat criteria of 1.9 ppm. PCB concentrations in other fish, such as rock bass (estimated to be 0.5 ppm for fillets) also exceeded the State's safe level for fish of 0.05 ppm PCB. In order to reduce PCBs to acceptable levels in fish, 2003 calculations determined that PCB levels in sediments would need to be lowered about five-fold to reach a cancer level of 1 in 10,000 (level for fish advisories) and about ten-fold to achieve an acceptable noncancer risk level. Based on 2003 calculations, average PCB levels in sediment would need to be reduced to an overall SWAC of 0.25 ppm PCB to properly protect public health (Clark, 2003).

In 2006, a risk evaluation was performed to verify and document that the recommended PCB cleanup concentration for sediment (i.e., SWAC of 0.25 mg/kg) would be adequate to protect potentially exposed populations that consume fish from Waukegan Harbor. Fish tissue results collected during 2001 to 2005 from the IEPA and sediment data from USEPA's 2003 and 2005 investigations were used to establish an empirical relationship between the PCB concentrations in sediment and fish tissue and risk-based sediment cleanup levels were calculated corresponding to various fish consumption rates. These results indicate that a sediment cleanup goal of a SWAC of 0.2 mg/kg total PCBs is protective of high-consumption consumers of fish from the harbor. The application of the remedial goal (0.2 mg/kg SWAC) to the Waukegan Harbor sediment cleanup as it relates to the dredge depth and volume of the environmental dredging, and the thickness of clean cover(s) will be evaluated in the subsequent FS report.

6.4.2 Fish Tissue

In February 2006, IDPH issued a state-wide sports fish consumption advisory for Illinois waters that included the "Waukegan North Harbor of Lake Michigan." IDPH recommended that meals of white sucker and sunfish taken from the harbor be limited to one per month due to the elevated levels of PCBs in fish. All other species caught in the harbor should

follow the advisory for Lake Michigan fish concerning PCB and methylmercury levels (USEPA, 2007).

6.4.3 Asbestos

Although there were detectable levels of asbestos fibers in a small sample set collected by USACE in 2006, their evaluation of the potential risk to human health from this material indicated there is no further risk evaluation required for the material, and that the Outer Harbor sediment could be re-used on land without further consideration of asbestos risk.

6.5 Ecological Risk Assessment for PCBs

Factors that limit Waukegan Harbor's value as a habitat include regular industrial boat traffic that stirs up and muddies the harbor waters, dredging operations that disturb harbor sediments and affect surface water quality, and the lack of cover provided by the deep, vertical harbor walls (CH2M HILL, 1995). The most significant ecological features in the vicinity of Waukegan Harbor include Lake Michigan and its shoreline and the beach and dune areas east of the harbor. Terrestrial habitat exists immediately adjacent to the harbor, but is limited to maintained/mowed grassy areas (e.g., the WCP site, the former Slip 3 containment cell, and the Warren Siver Park), gravel areas, and paved parking lots. Wetland areas do not occur immediately adjacent to the harbor. None of these areas support significant terrestrial habitat.

Fish and macroinvertebrates reside in harbor waters and have limited or nonexistent mobility, indicating these species are likely to spend a major portion of their entire life cycle within the study area. The Lake Michigan sport-fishing catch consists primarily of yellow perch, chinook and coho salmon, and steelhead, brown, and lake trout. Two state-threatened fish species, the longnose sucker and the lake whitefish, have been reported in Lake Michigan between Zion and Waukegan. The last sightings of these species were in 1985 for the longnose sucker and in 1991 for the lake whitefish (CH2M HILL, 1995).A sediment toxicity study for Waukegan Harbor was completed by USEPA in 1999, representing post-1992 remediation activities. In general, these test results are considered applicable to current conditions as additional dredging activities have not been conducted and PCBs do not appreciably degrade or easily attenuate. Sediment samples from Waukegan Harbor were generally found to be not lethal to amphipods—only 6 of the 20 sediment samples were toxic. However, amphipod growth was significantly reduced in all of the sediment samples compared to the control sediment after both 28 and 42 day time periods. The available guidelines during the study for evaluation of Great Lakes harbor sediment classified sediment samples as moderately toxic if total PCB concentrations range from 1 to 10 µg/g (ppb). Based on the criteria, 18 of 19 sediment samples used in this study would be classified as moderately toxic based on their total PCB concentrations (USEPA, 1999b).

SECTION 7

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Figures

Appendix A
Summary of Physical Data

Appendix B
Summary of Chemical Data

N

0 1,200

Feet

Figure 1
Site Location Map
Waukegan Harbor
Waukegan, Illinois

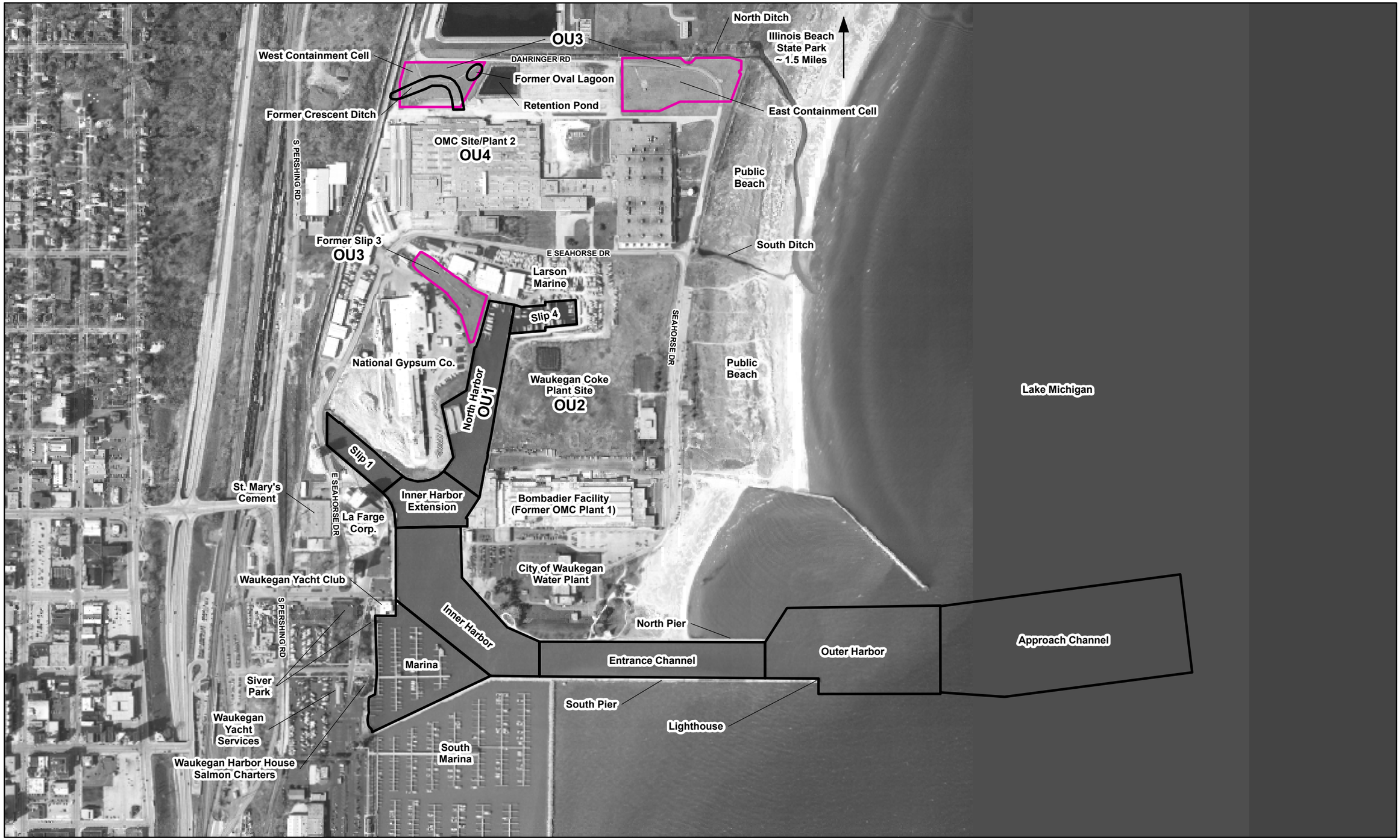

Figure 2
Site Vicinity Facilities
Waukegan Harbor
Waukegan, Illinois

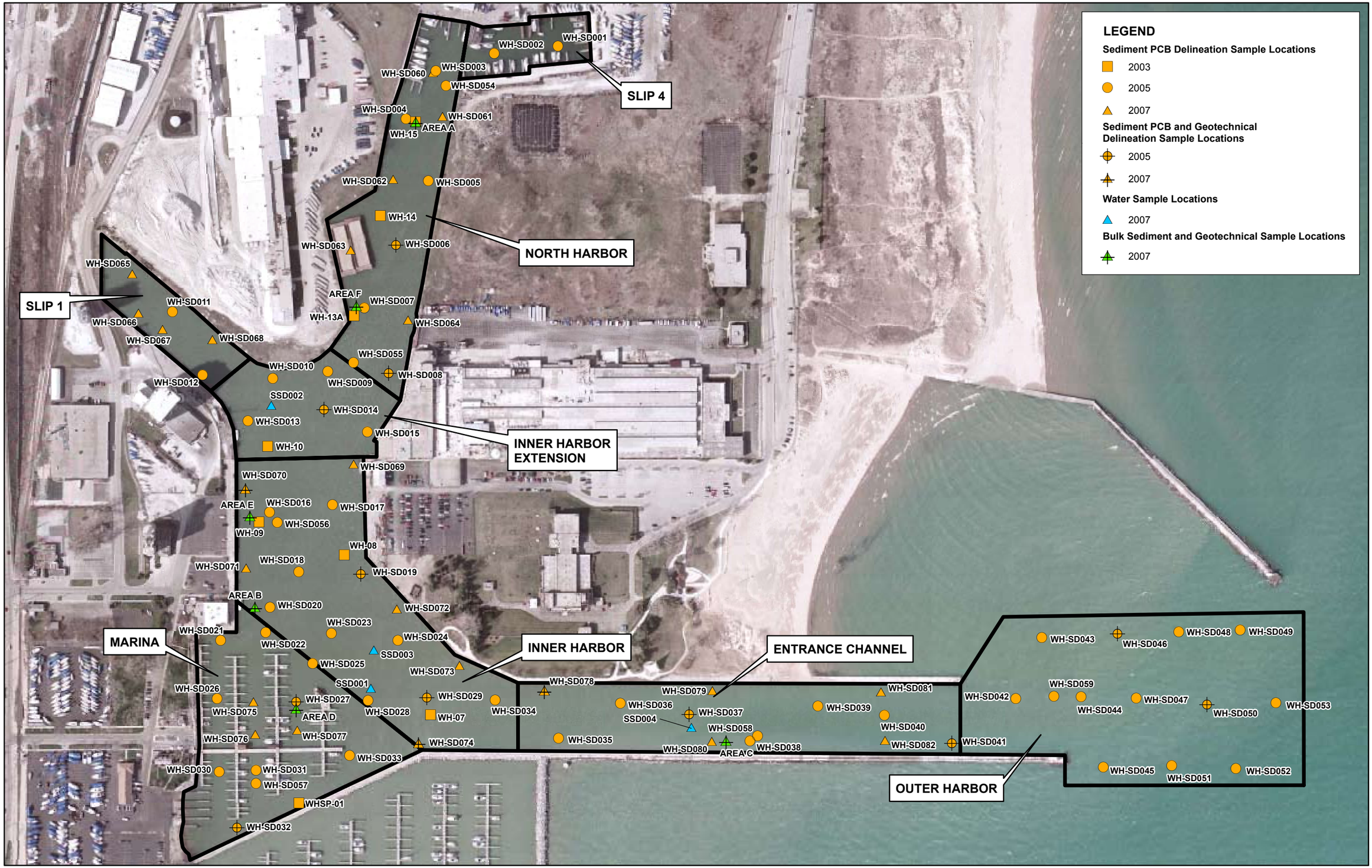

Figure 3
Harbor Segments and Sample Locations
Waukegan Harbor
Waukegan, Illinois

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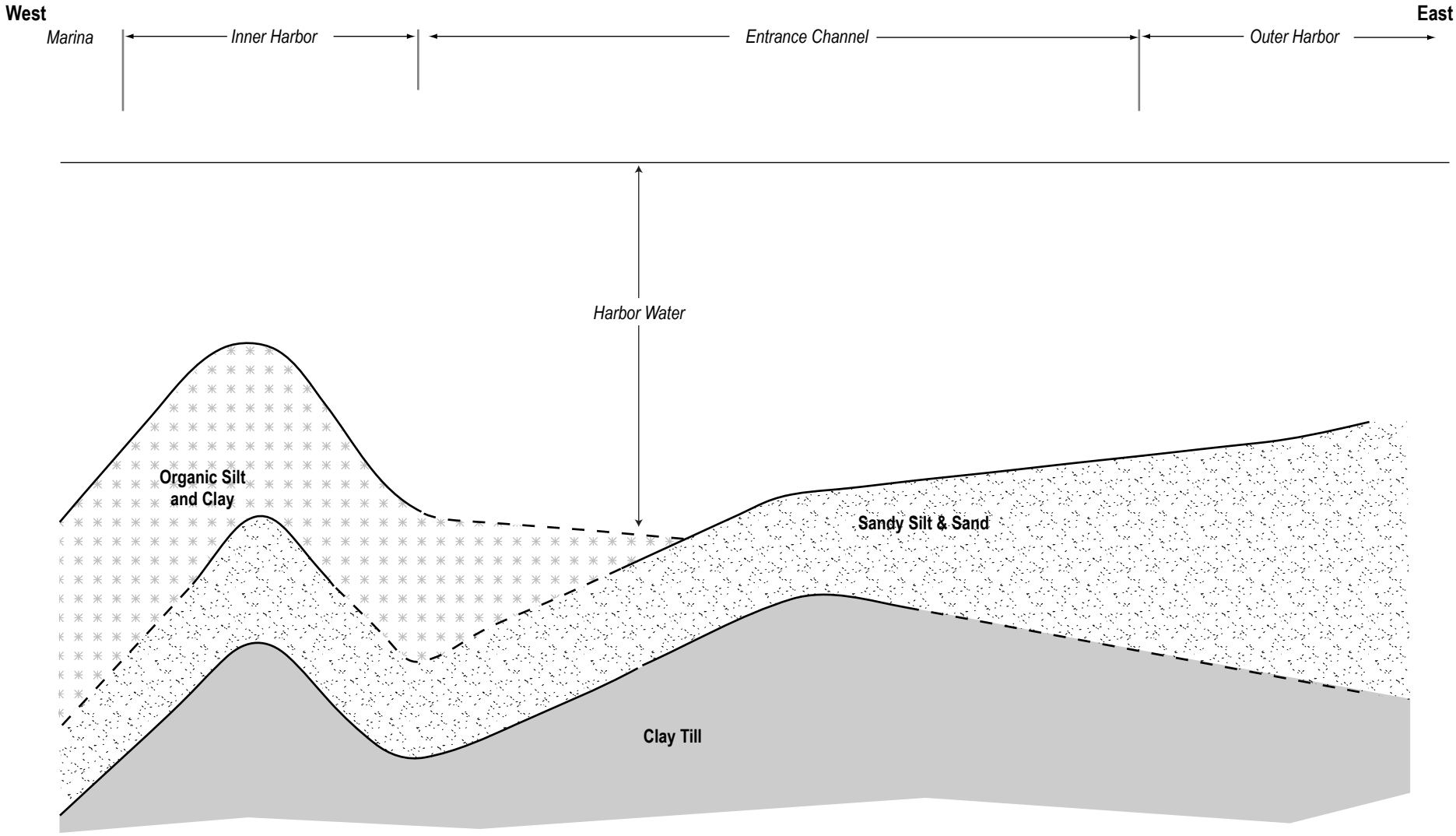

Approximate Scale:

1" = 5'

1" = 300'

Vertical Exaggeration = 60X

Not to Scale

Figure 4

Conceptual Depiction of Harbor Sediment Types West to East

Waukegan Harbor

CH2MHILL

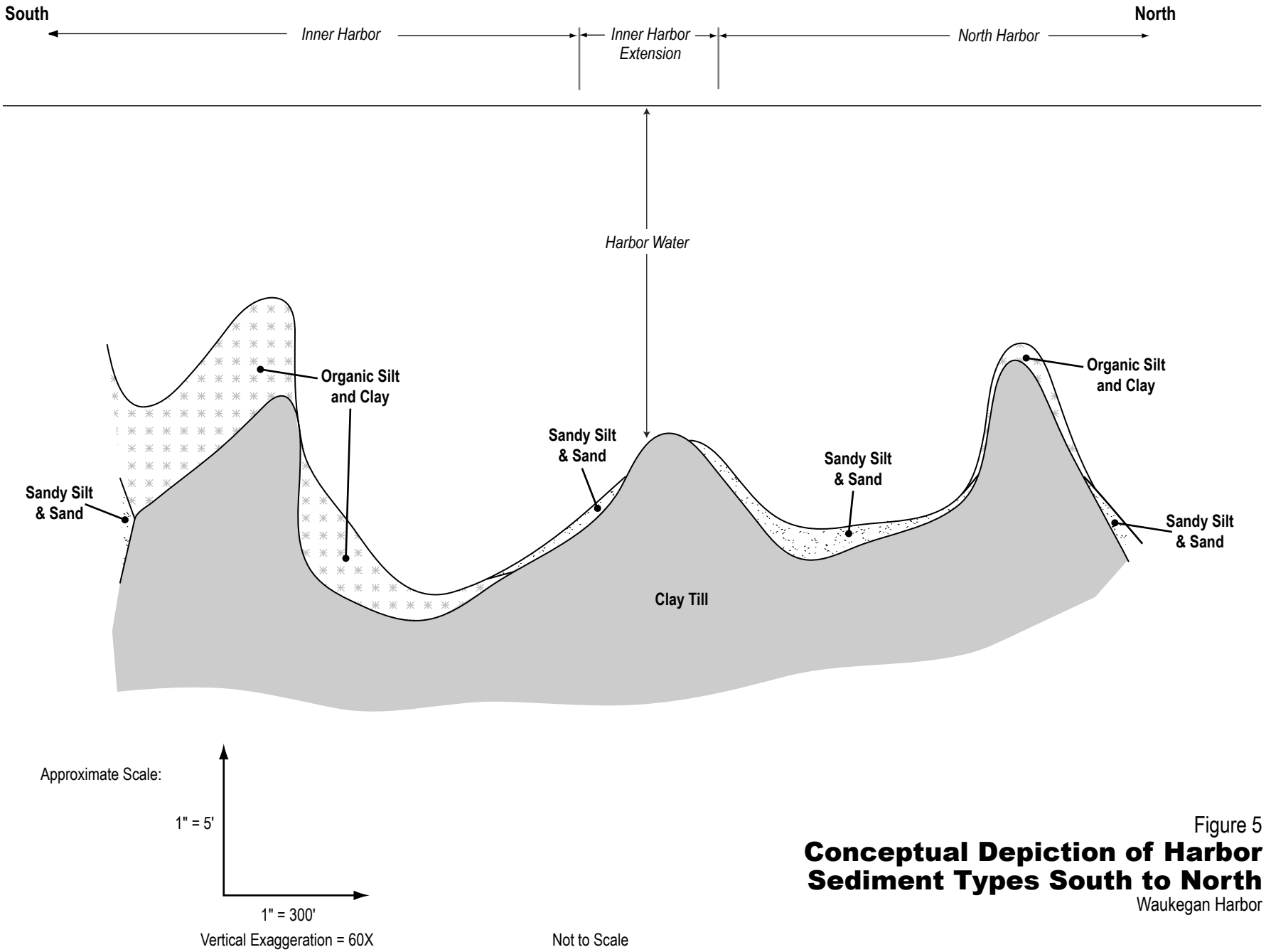

Figure 5

Conceptual Depiction of Harbor Sediment Types South to North

Waukegan Harbor

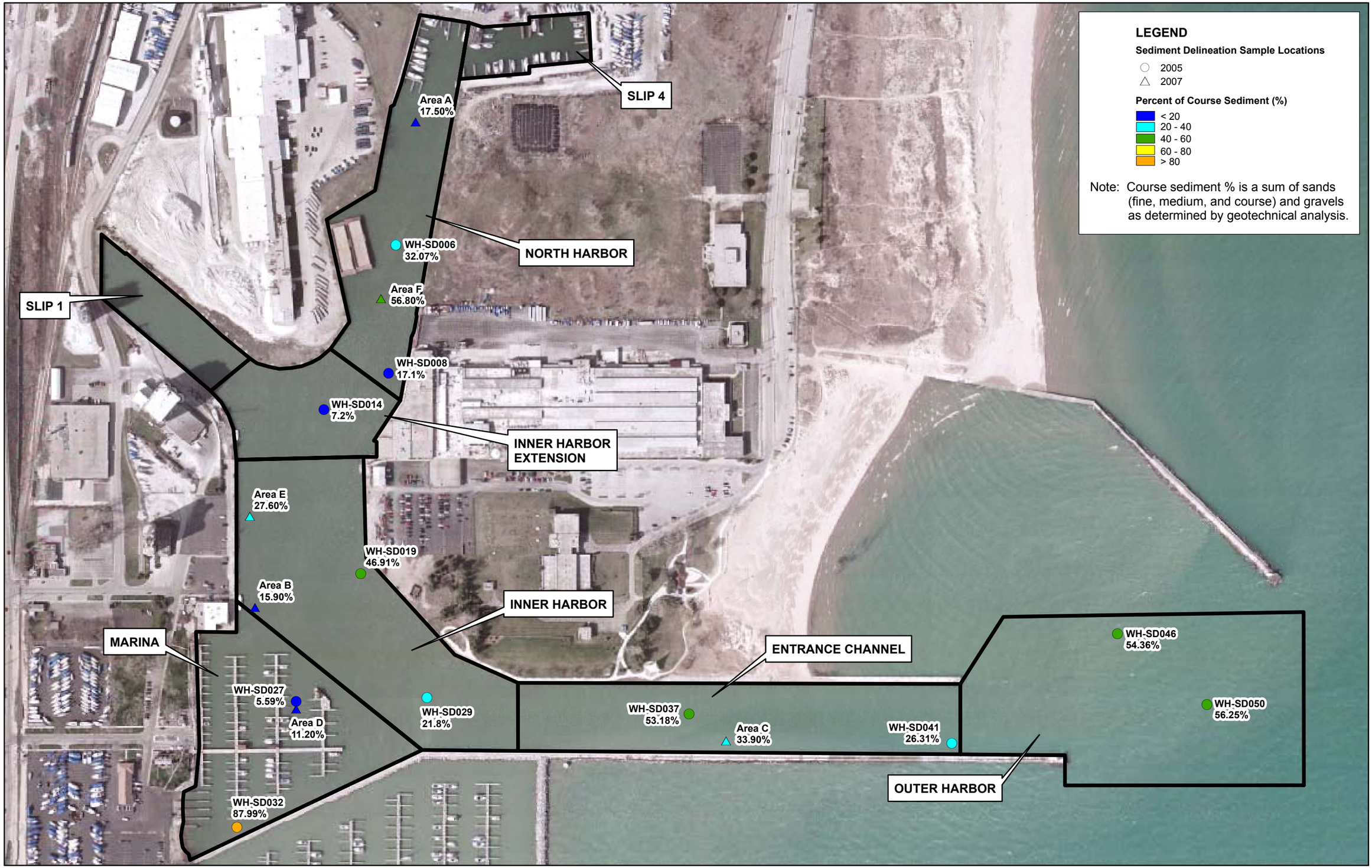

Figure 6
Coarse Sediment Distribution
Waukegan Harbor
Waukegan, Illinois

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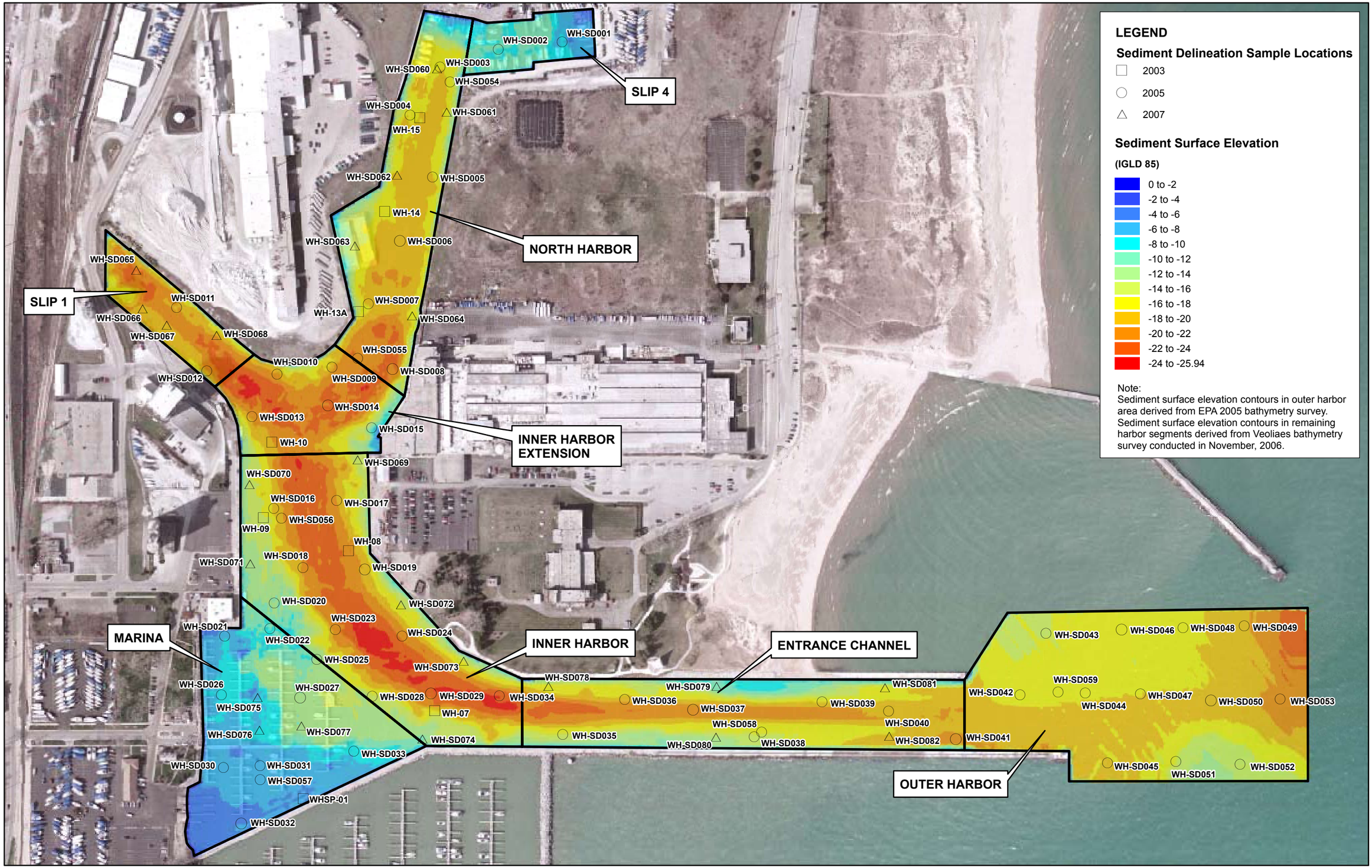


Figure 8
Sediment Surface Elevation
Waukegan Harbor
Waukegan, Illinois

CH2MHILL

MKE \\WAVE\PROJ\EPA\182500_WAUKEGAN_HARBOR\GIS_DATA\MXDS\2008\RI_REPORT\FINAL_RI_REPORT\FIGURE08_WAUKEGAN_HARBOR_FINAL_SEDIMENT_SURFACE_ELEVATION.MXD 2/11/2008 09:59:59

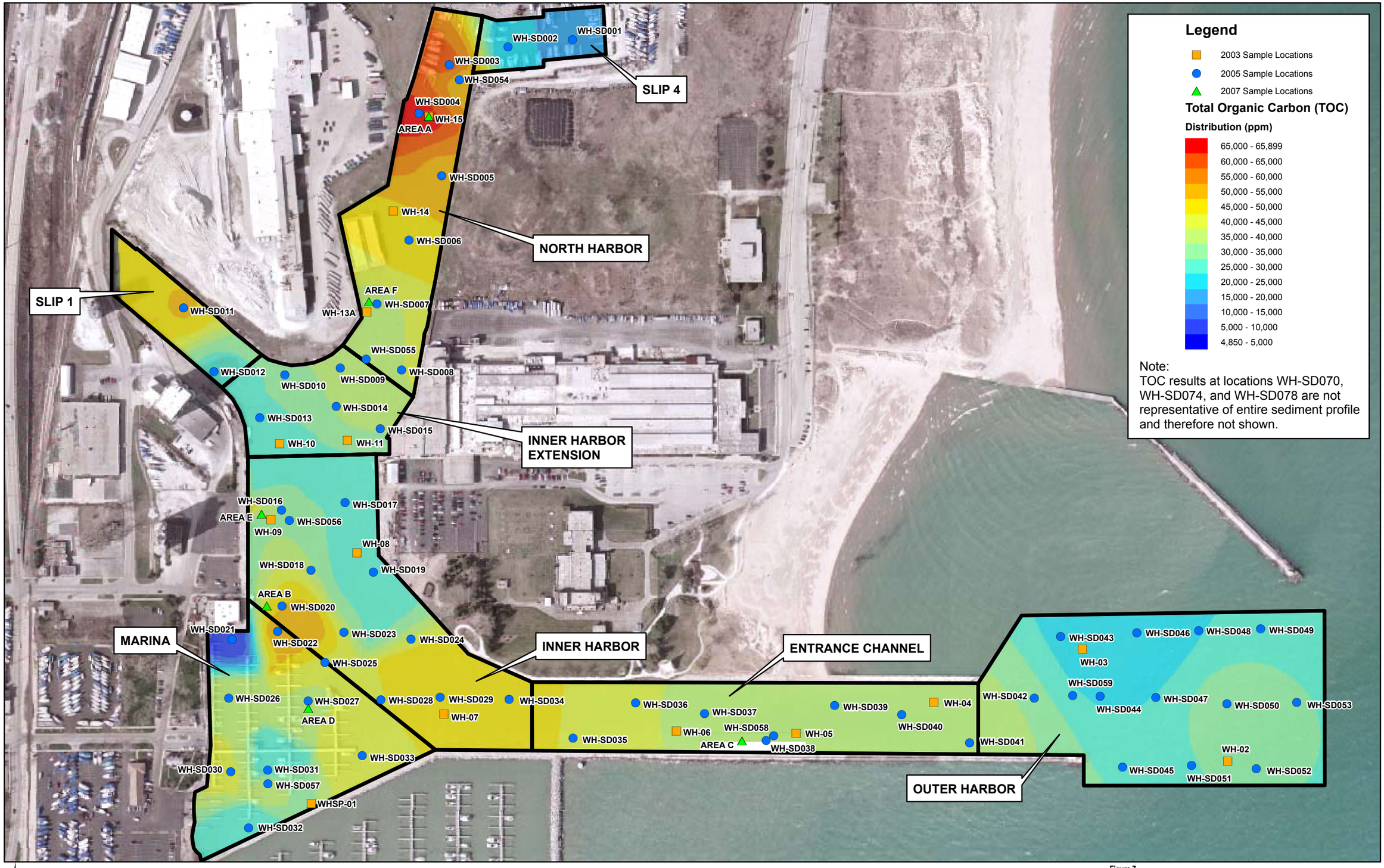


Figure 7
Total Organic Carbon Distribution
Waukegan Harbor
Waukegan, Illinois

MKE \\WAVE\PROJ\EPA\182500_WAUKEGAN_HARBOR\GIS_DATA\MXDS\2008\RI_REPORT\FINAL_RI_REPORT\FIGURE07_WAUKEGAN_HARBOR_TOC_DISTRIBUTION.MXD 2/11/2008 09:50:24

CH2MHILL

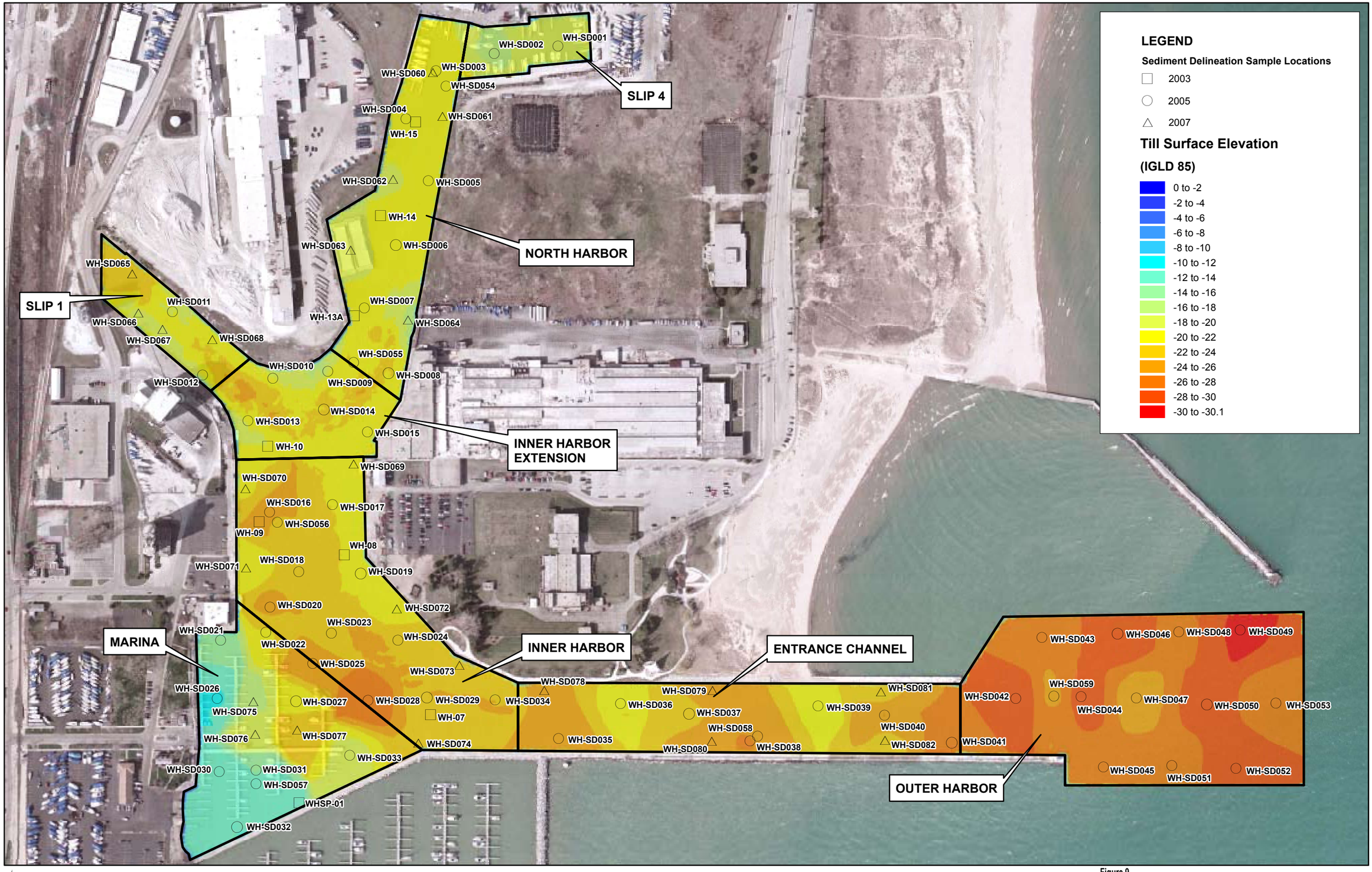


Figure 9
Till Surface Elevation
Waukegan Harbor
Waukegan, Illinois

CH2MHILL

MKE \\WAVE\PROJ\EPA\182500_WAUKEGAN_HARBOR\GIS_DATA\MXDS\2008\RI_REPORT\FINAL_RI_REPORT\FIGURE09_WAUKEGAN_HARBOR_FINAL_TILL_SURFACE_ELEVATION.MXD 2/11/2008 10:11:38

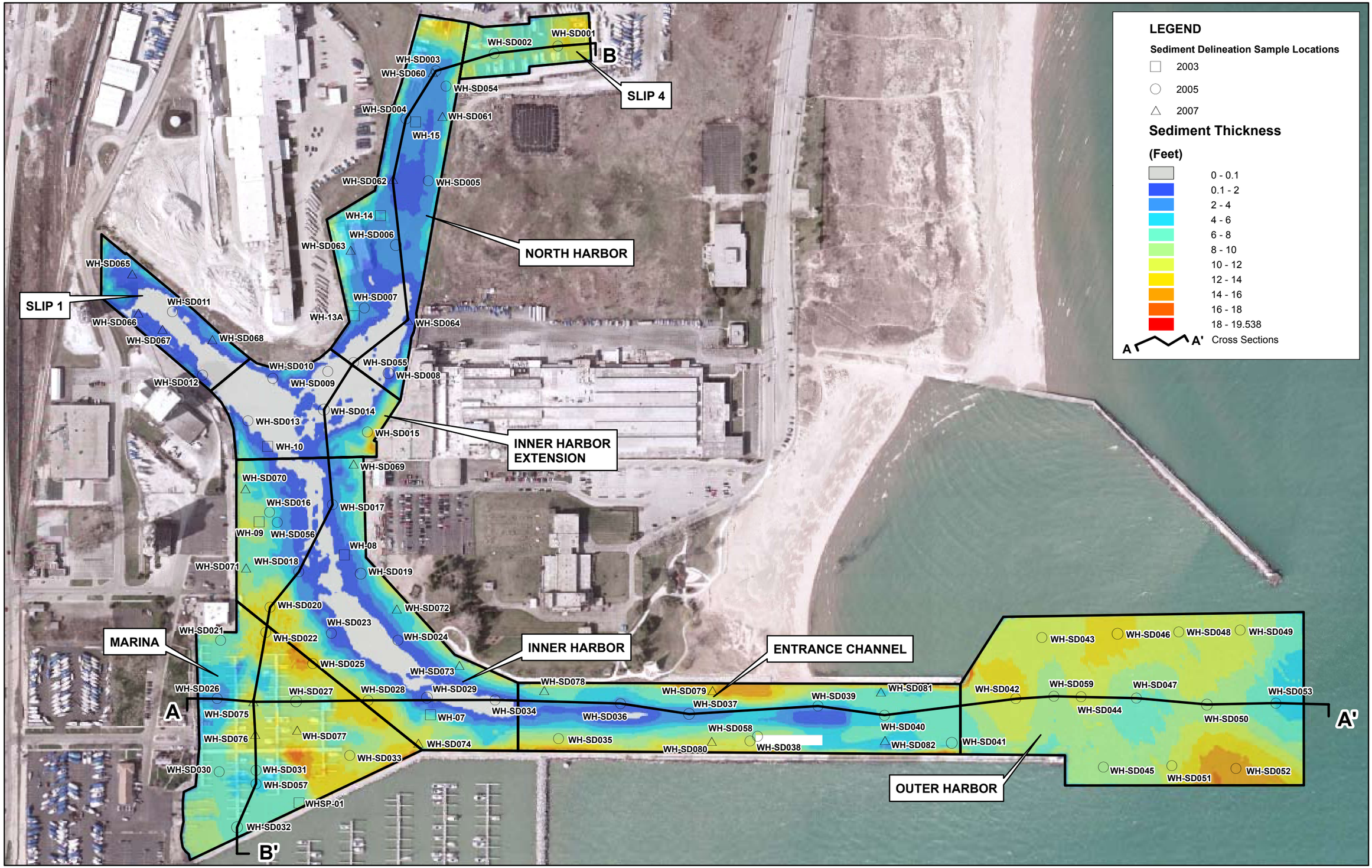
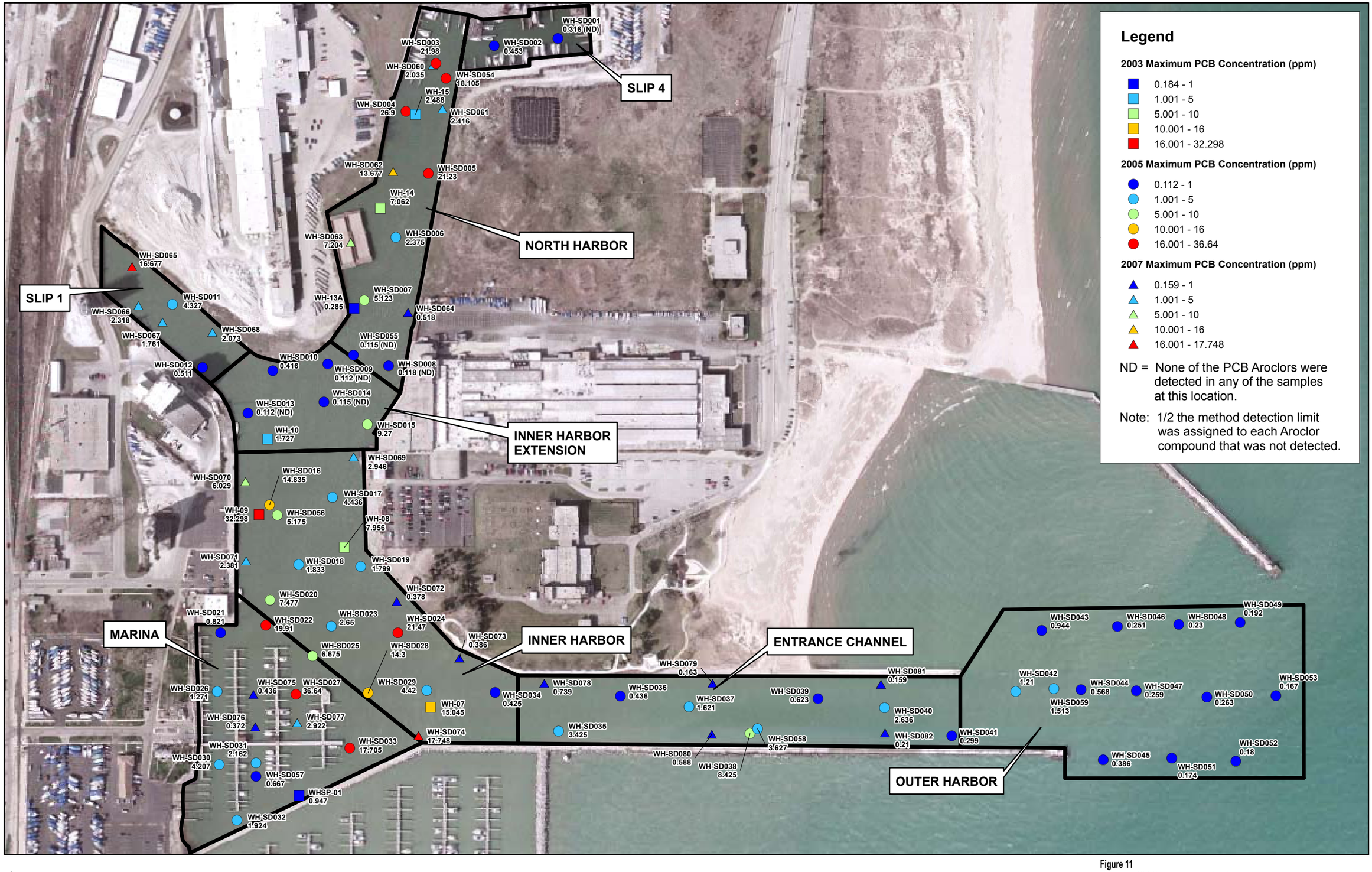


Figure 10
Sediment Thickness
Waukegan Harbor
Waukegan, Illinois

CH2MHILL

MKE \\WAVE\PROJ\EPA\182500_WAUKEGAN_HARBOR\GIS_DATA\MXDS\2008\RI_REPORT\FINAL_RI_REPORT\FIGURE10_WAUKEGAN_HARBOR_FINAL_SEDIMENT_THICKNESS.MXD 2/11/2008 10:18:06



Legend

2003 Maximum PCB Concentration (ppm)

- 0.184 - 1
- 1.001 - 5
- 5.001 - 10
- 10.001 - 16
- 16.001 - 32.298

2005 Maximum PCB Concentration (ppm)

- 0.112 - 1
- 1.001 - 5
- 5.001 - 10
- 10.001 - 16
- 16.001 - 36.64

2007 Maximum PCB Concentration (ppm)

- 0.159 - 1
- 1.001 - 5
- 5.001 - 10
- 10.001 - 16
- 16.001 - 17.748

ND = None of the PCB Aroclors were detected in any of the samples at this location.

Note: 1/2 the method detection limit was assigned to each Aroclor compound that was not detected.

N

0 150 300

Feet

Figure 11
Maximum PCB Concentrations within the Sediment Column at each Sample Location
Waukegan Harbor
Waukegan, Illinois

MKE \\WAVE\PROJ\EPA\182500_WAUKEGAN_HARBOR\GIS_DATA\MXDS\2008\RI_REPORT\FINAL_RI_REPORT\FIGURE11_WAUKEGAN_HARBOR_MAXIMUM_PCB_CONCENTRATIONS.MXD 2/11/2008 10:26:08

CH2MHILL

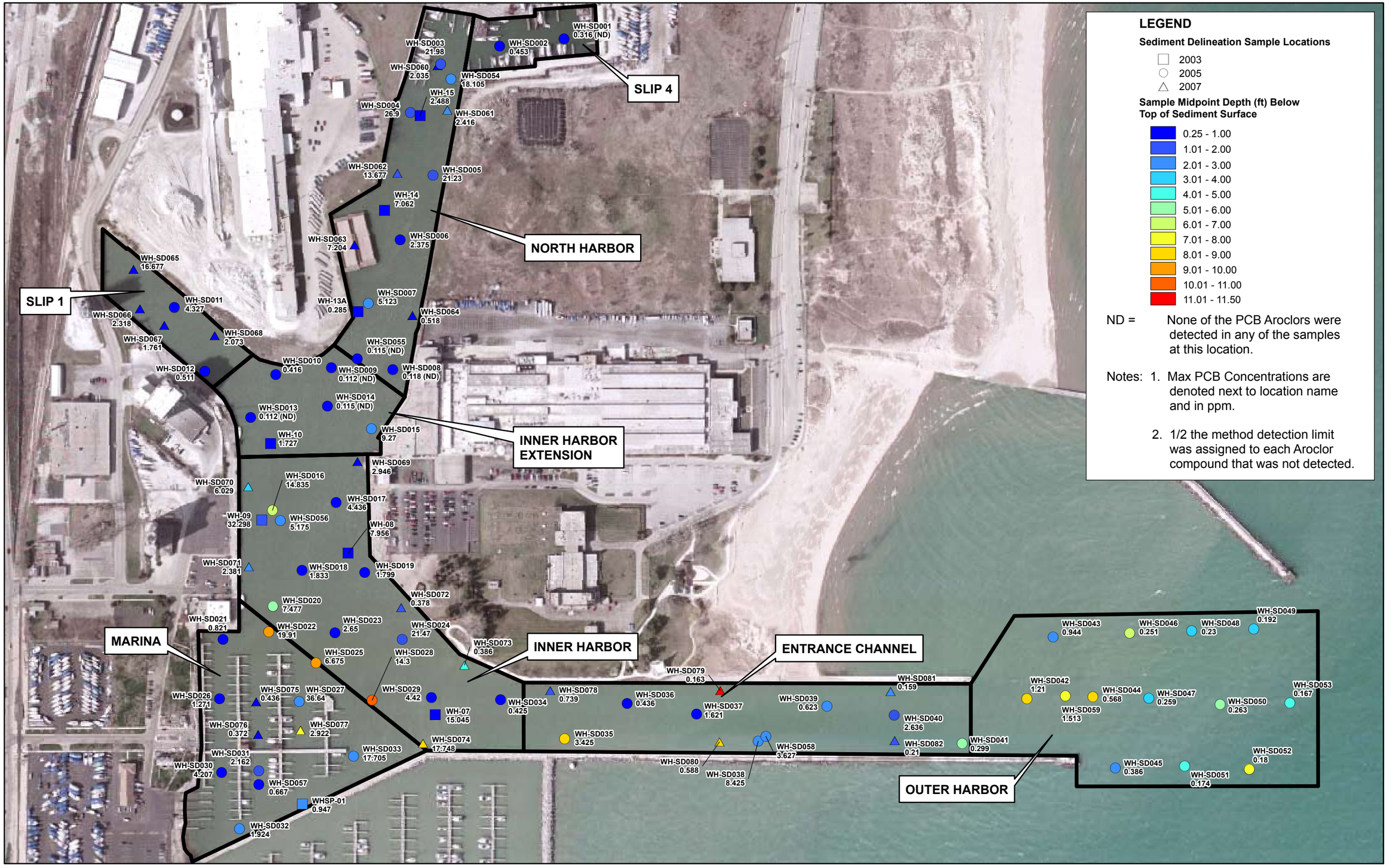


Figure 12
Sediment Depth at which Maximum PCB Concentrations are located at each Sample Location
Waukegan Harbor
Waukegan, Illinois

CH2MHILL

MKE \\WAVE\PROJ\EPA\182500_WAUKEGAN_HARBOR\GIS_DATA\MXDS\2008\RI_REPORT\FINAL_RI_REPORT\FIGURE12_WAUKEGAN_HARBOR_MAXIMUM_PCB_CONCENTRATIONS_AT_DEPTH.MXD 2/11/2008 10:29:03

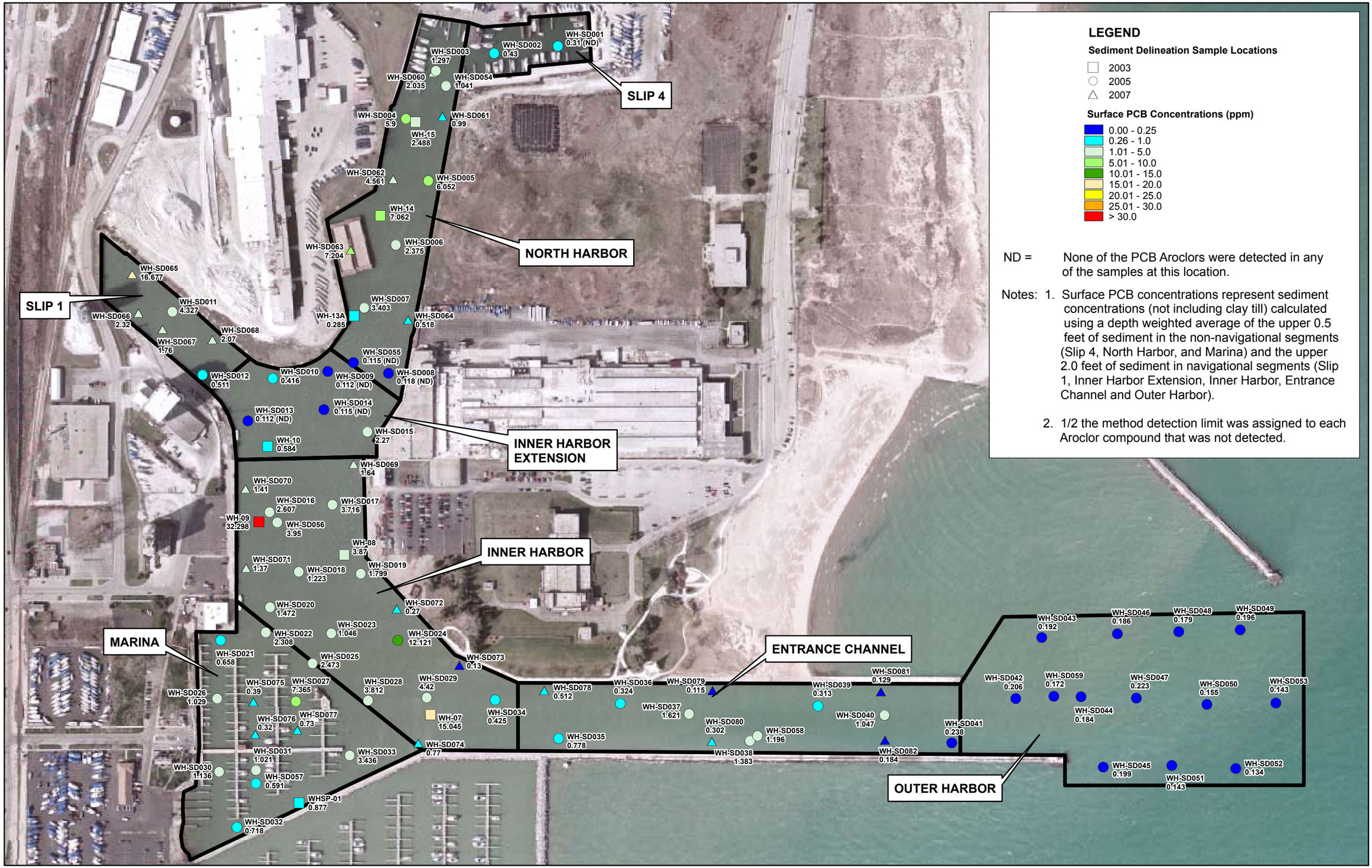


Figure 13
Sediment Surface PCB Concentrations
Waukegan Harbor
Waukegan, Illinois

CH2MHILL

MKE \\WAVE\PROJ\EPA\182500_WAUKEGAN_HARBOR\GIS_DATA\MXDS\2008\RI_REPORT\FINAL_RI_REPORT\FIGURE13_WAUKEGAN_HARBOR_SURFACE_PCB_CONCENTRATIONS.MXD 2/11/2008 10:55:06

WEST

EAST

MARINA

INNER HARBOR

ENTRANCE CHANNEL

WH-SD-026 | WH-SD-075 | WH-SD-027 | WH-SD-028 | WH-SD-029 | WH-SD-034 | WH-SD-036 | WH-SD-037 | WH-SD-039 | WH-SD-040

0.868
1.271
0.127 (ND)
0.127 (ND)
0.124 (ND)
0.115 (ND)
0.129
0.392
0.436
0.282
0.19
TOP OF SEDIMENT
0.141
0.11 (ND)
0.1075 (ND)
0.1025 (ND)
0.11 (ND)
0.115 (ND)
5.471
10.205
10.820
8.025
6.140
36.640
31.705
23.610
25.595
15.550
8.075
4.674
5.463
4.875
6.158
TOP OF TILL
3.260
4.363
9.605
5.558
1.763
4.464
8.374
4.960
9.263
8.858
14.300
7.338
4.420
0.425
0.436
0.211
0.115 (ND)
1.621
1.170
0.109
0.271
0.354
0.371
0.623
0.128
0.115 (ND)
0.316
0.478
2.636
0.758
0.127 (ND)
0.529
0.127 (ND)

MATCHLINE SEE FIGURE M-2

0 | -5 | -10 | -15 | -20 | -25 | -30 | -35

50+00 | 51+00 | 52+00 | 53+00 | 54+00 | 55+00 | 56+00 | 57+00 | 58+00 | 59+00 | 60+00 | 61+00 | 62+00 | 63+00 | 64+00 | 65+00 | 66+00 | 67+00 | 68+00 | 69+00 | 70+00 | 71+00 | 72+00 | 73+00 | 74+00 | 75+00

LEGEND / ABBREVIATIONS

- ○ SAMPLE LOCATION TOTAL PCB < 1 PPM
- ● SAMPLE LOCATION TOTAL PCB ≥ 1 PPM
- ---------- TOP OF SEDIMENT
- ———— TOP OF TILL

ND	NON-DETECT
PCB	POLYCHLORINATED BIPHENYLS
PPM	PARTS PER MILLION

0' 5' Vertical

0' 200' Horizontal

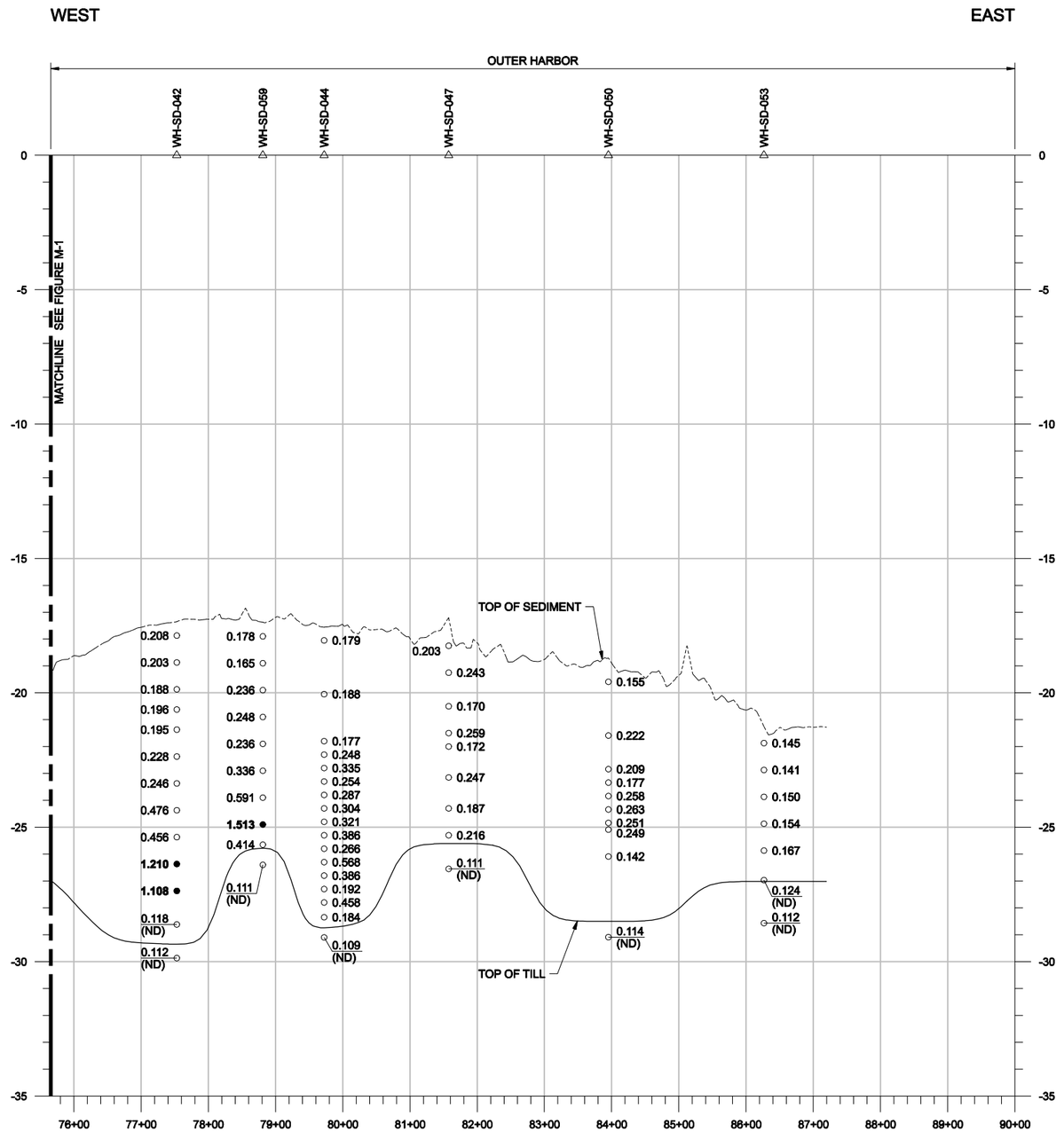
NOTES:

1. SAMPLE DATA REPRESENTS TOTAL PCB CONCENTRATIONS (PPM) AT MIDPOINT ELEVATION OF SAMPLE INTERVAL.
2. ELEVATIONS ARE REPRESENTED IN IGLD85 (INTERNATIONAL GREAT LAKES DATUM 1985).
3. TOP OF SEDIMENT ELEVATIONS IN OUTER HARBOR ARE DERIVED FROM EPA 2005 BATHYMETRY SURVEY DATA. REMAINING HARBOR SEGMENTS USE BATHYMETRIC SURVEY DATA COLLECTED BY VEOLIA ENVIRONMENTAL SERVICES IN NOVEMBER, 2006. ELEVATIONS OF PCB SAMPLES COLLECTED PRIOR TO NOVEMBER, 2006 (WH-SD001 THROUGH WH-SD059) MAY NOT MATCH WITH CURRENT BATHYMETRIC DATA.

FIGURE 14A
SECTION A-A' OF FIGURE 10
WAUKEGAN HARBOR AREA OF CONCERN
WAUKEGAN, ILLINOIS

CH2MHILL

FILENAME: fe05c273_366506.dgn PLOT DATE: 2/11/2008 PLOT TIME: 2:46:59 PM



LEGEND / ABBREVIATIONS

○	SAMPLE LOCATION TOTAL PCB < 1 PPM
●	SAMPLE LOCATION TOTAL PCB ≥ 1 PPM
----------	TOP OF SEDIMENT
————	TOP OF TILL
ND	NON-DETECT
PCB	POLYCHLORINATED BIPHENYLS
PPM	PARTS PER MILLION

0' 5' Vertical

0' 200' Horizontal

NOTES:

1. SAMPLE DATA REPRESENTS TOTAL PCB CONCENTRATIONS (PPM) AT MIDPOINT ELEVATION OF SAMPLE INTERVAL.
2. ELEVATIONS ARE REPRESENTED IN IGLD85 (INTERNATIONAL GREAT LAKES DATUM 1985).
3. TOP OF SEDIMENT ELEVATIONS IN OUTER HARBOR ARE DERIVED FROM EPA 2005 BATHYMETRY SURVEY DATA. REMAINING HARBOR SEGMENTS USE BATHYMETRIC SURVEY DATA COLLECTED BY VEOLIA ENVIRONMENTAL SERVICES IN NOVEMBER, 2006. ELEVATIONS OF PCB SAMPLES COLLECTED PRIOR TO NOVEMBER, 2006 (WH-SD001 THROUGH WH-SD059) MAY NOT MATCH WITH CURRENT BATHYMETRIC DATA.

FIGURE 14B
SECTION A-A' OF FIGURE 10
WAUKEGAN HARBOR AREA OF CONCERN
WAUKEGAN, ILLINOIS

CH2MHILL

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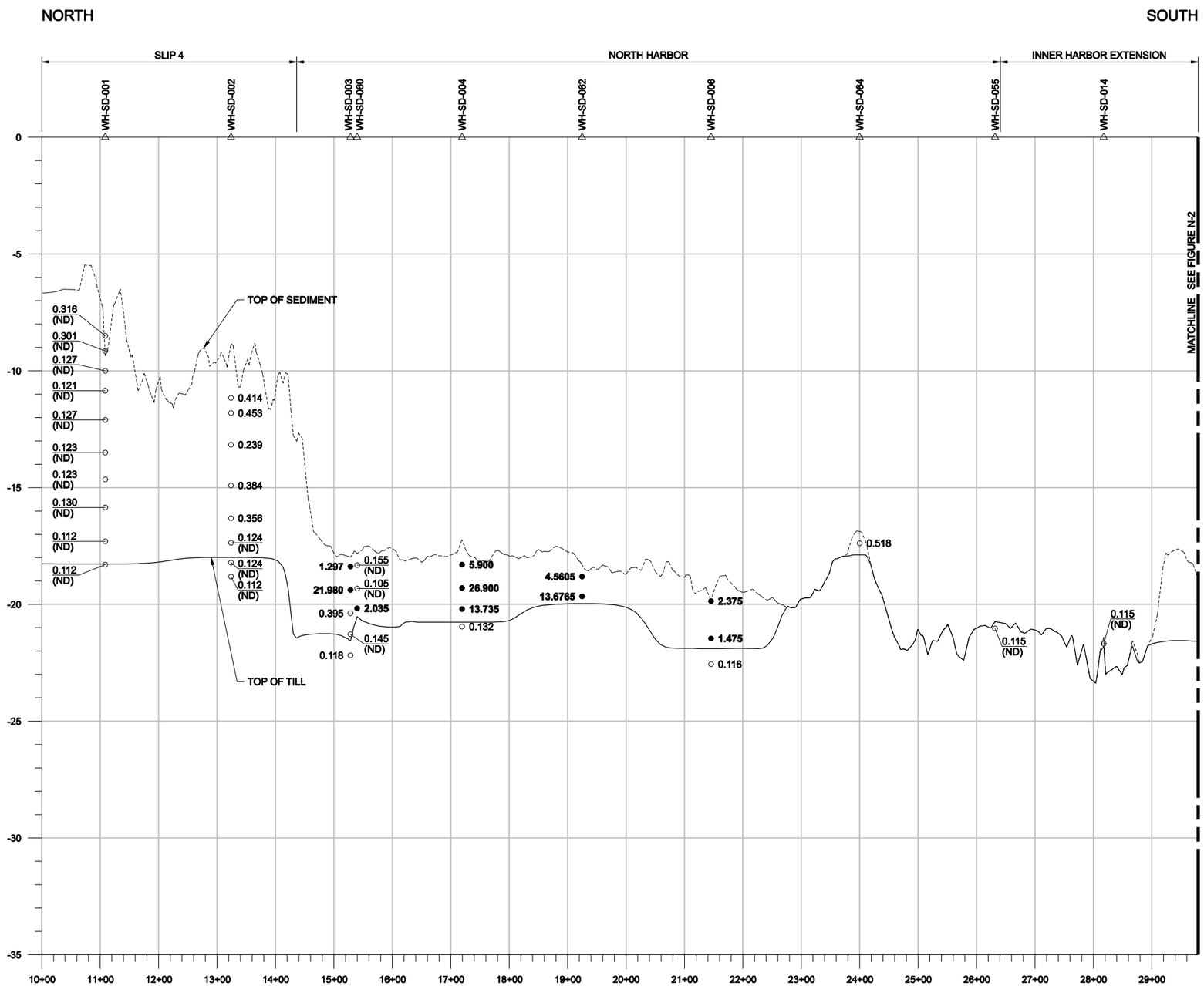


LEGEND / ABBREVIATIONS

- ○ SAMPLE LOCATION TOTAL PCB < 1 PPM
- ● SAMPLE LOCATION TOTAL PCB ≥ 1 PPM
- ---------- TOP OF SEDIMENT
- ———— TOP OF TILL

ND	NON-DETECT
PCB	POLYCHLORINATED BIPHENYLS
PPM	PARTS PER MILLION

0' 5' Vertical

0' 200' Horizontal

NOTES:

1. SAMPLE DATA REPRESENTS TOTAL PCB CONCENTRATIONS (PPM) AT MIDPOINT ELEVATION OF SAMPLE INTERVAL.
2. ELEVATIONS ARE REPRESENTED IN IGLD85 (INTERNATIONAL GREAT LAKES DATUM 1985).
3. TOP OF SEDIMENT ELEVATIONS IN OUTER HARBOR ARE DERIVED FROM EPA 2005 BATHYMETRY SURVEY DATA. REMAINING HARBOR SEGMENTS USE BATHYMETRIC SURVEY DATA COLLECTED BY VEOLIA ENVIRONMENTAL SERVICES IN NOVEMBER, 2006. ELEVATIONS OF PCB SAMPLES COLLECTED PRIOR TO NOVEMBER, 2006 (WH-SD001 THROUGH WH-SD059) MAY NOT MATCH WITH CURRENT BATHYMETRIC DATA.

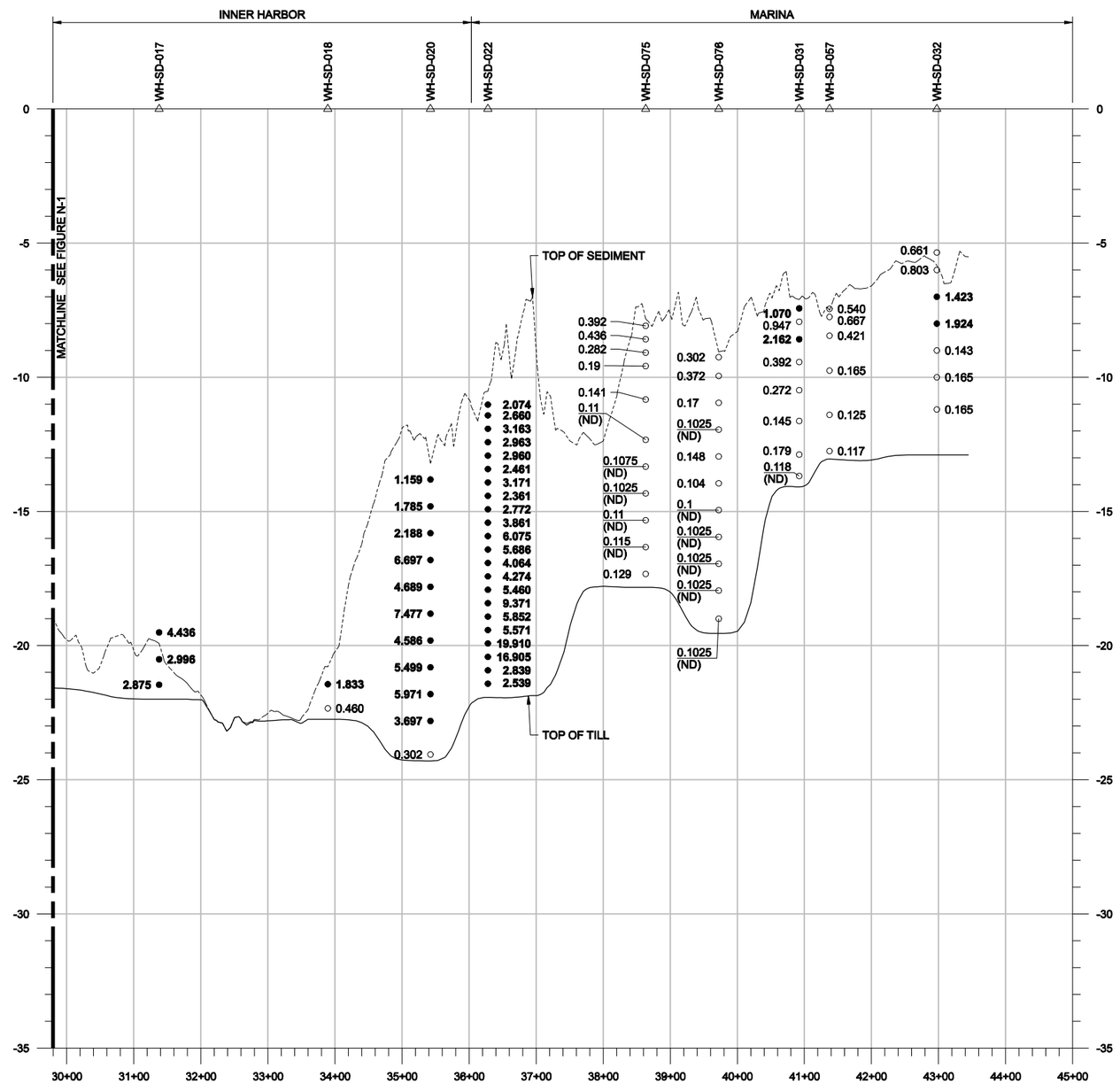
FIGURE 15A
SECTION B-B' OF FIGURE 10
WAUKEGAN HARBOR AREA OF CONCERN
WAUKEGAN, ILLINOIS

CH2MHILL

FILENAME: fe05c271_366506.dgn PLOT DATE: 2/11/2008 PLOT TIME: 2:46:50 PM

NORTH

SOUTH



LEGEND / ABBREVIATIONS

- ○ SAMPLE LOCATION TOTAL PCB < 1 PPM
- ● SAMPLE LOCATION TOTAL PCB ≥ 1 PPM
- ---------- TOP OF SEDIMENT
- ———— TOP OF TILL

ND	NON-DETECT
PCB	POLYCHLORINATED BIPHENYLS
PPM	PARTS PER MILLION

0' 5'
Vertical

0' 200'
Horizontal

NOTES:

1. SAMPLE DATA REPRESENTS TOTAL PCB CONCENTRATIONS (PPM) AT MIDPOINT ELEVATION OF SAMPLE INTERVAL.
2. ELEVATIONS ARE REPRESENTED IN IGLD85 (INTERNATIONAL GREAT LAKES DATUM 1985).
3. TOP OF SEDIMENT ELEVATIONS IN OUTER HARBOR ARE DERIVED FROM EPA 2005 BATHYMETRY SURVEY DATA. REMAINING HARBOR SEGMENTS USE BATHYMETRIC SURVEY DATA COLLECTED BY VEOLIA ENVIRONMENTAL SERVICES IN NOVEMBER, 2006. ELEVATIONS OF PCB SAMPLES COLLECTED PRIOR TO NOVEMBER, 2006 (WH-SD001 THROUGH WH-SD059) MAY NOT MATCH WITH CURRENT BATHYMETRIC DATA.

FIGURE 15B
SECTION B-B' OF FIGURE 10
WAUKEGAN HARBOR AREA OF CONCERN
WAUKEGAN, ILLINOIS

CH2MHILL

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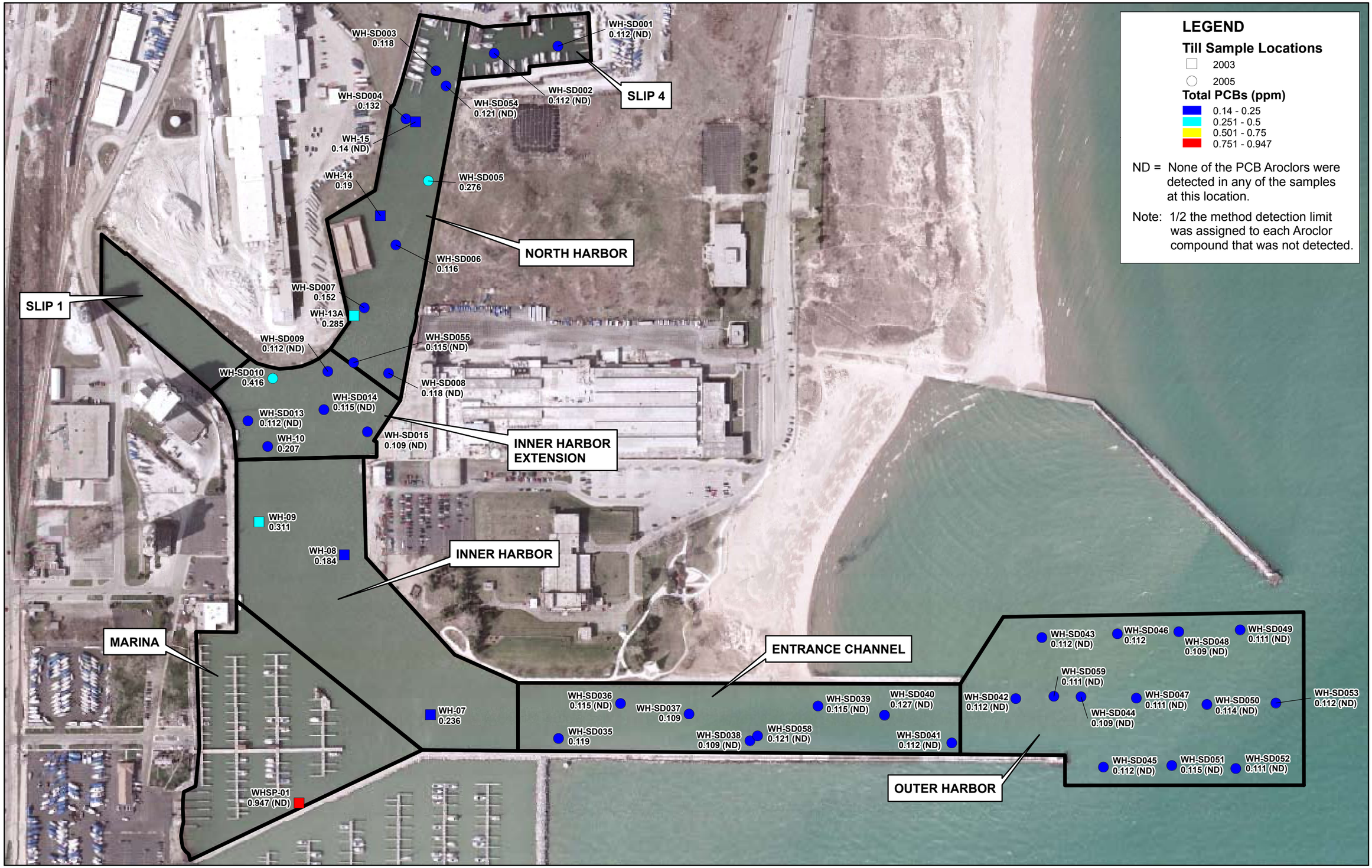

Figure 16
Total PCB Concentrations in Clay Till Samples
Waukegan Harbor
Waukegan, Illinois

CH2MHILL

MKE \\WAVE\PROJ\EPA\182500_WAUKEGAN_HARBOR\GIS_DATA\MXDS\2008\RI_REPORT\FINAL_RI_REPORT\FIGURE16_WAUKEGAN_HARBOR_SURFACE_PCB_CONCENTRATIONS.MXD 2/11/2008 10:59:54

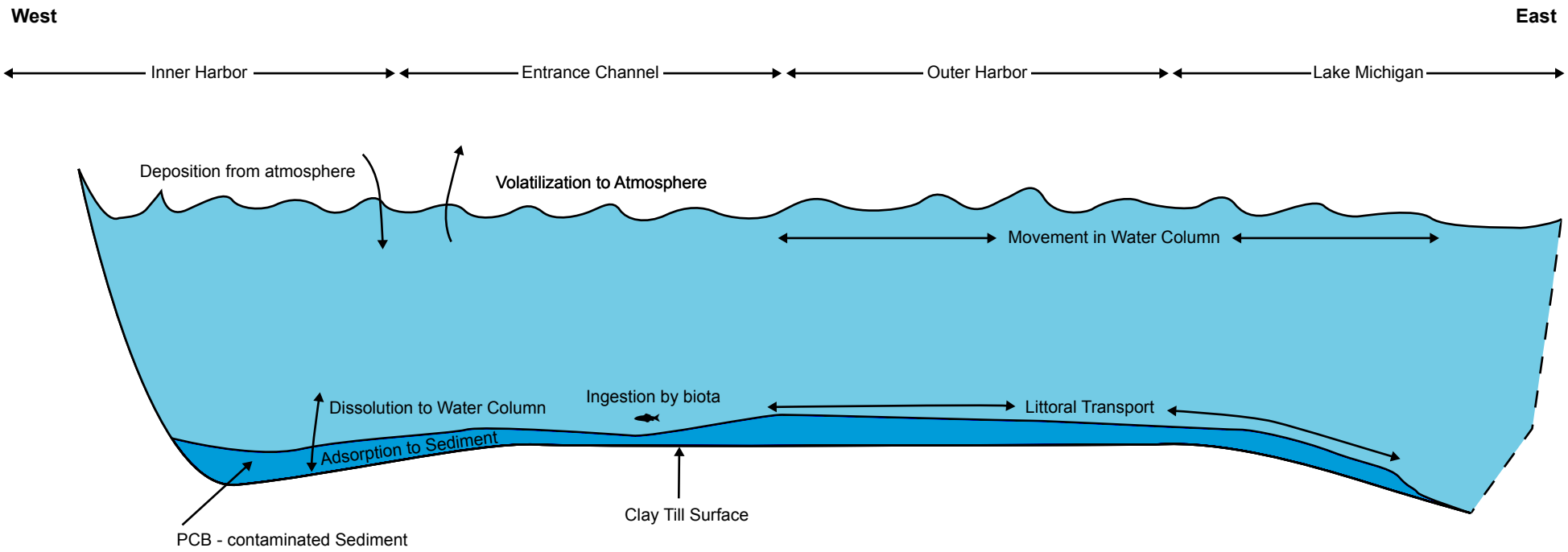

Figure 17

Conceptual Model of PCB Sediment Contamination Pathways

Waukegan Harbor

Not to Scale

TABLE A1

Geotechnical Analytical Result Summary

Waukegan Harbor Area of Concern

Segment >>>		North Harbor						Inner Harbor Extension	Inner Harbor						
Location Id >>>		Area A	Area F	WH-SD006	WH-SD006	WH-SD006	WH-SD008	WH-SD014	Area B	Area E	WH-SD019	WH-SD019	WH-SD029	WH-SD070	WH-SD074
Sample Interval (ft) >>>		0 - 3.5	0 - 3	0 - 2	2 - 3.25	3.33 - 4	0 - 1	0 - 1	0 - 11	0 - 11	0 - 1	2 - 3.17	0 - 0.58	0 - 2	0 - 2
Parameter Description	**Units**														
Bulk Density	g/cm^3	0.68	0.98	0.71	1.1	1.84	1.79	1.72	0.63	0.73	0.8	1.21	1.64	0.8	0.93
Liquid Limit	--	47	0	40	0	31	29	36	73	68	35	0	31	53	34
Percent Moisture	%	102.5	61.1	92.3	45.2	16.7	14.2	16.5	114.7	98	78.6	65.7	22.1	78.9	64.5
Percent Solids	%	46.3	67.5	--	--	--	--	--	46.6	48.9	--	--	--	56.8	54.4
Plastic Limit	--	33	0	0	0	16	15	16	42	38	0	0	18	32	31
Plasticity Index	--	14	NP	NP	NP	15	14	20	31	30	NP	NP	13	21	3
Specific Gravity	--	2.662	2.626	2.57	2.63	2.61	2.69	2.68	2.615	2.619	2.44	2.58	2.71	2.649	2.682
Total Organic Carbon	mg/kg	40,500	22,600	51,200	42,900	--	14,200	28,100	58,100	50,900	45,800	--	--	42,700	39,000
Soil Classification															
Organic Matter		--	--	6.7	4.5	3.8	2	2.3	--	--	7.9	5.1	2	--	--
Clay	%	25.5	14.5	33.2	26	48.3	51.6	60.2	34	28.8	20.4	16.9	41.2	21.9	15.1
Silt	%	57	28.7	37.8	31.2	30.4	31.2	32.6	50	43.7	32.1	36.7	37	33.1	52.2
Total Sand	%	17.5	55.7	29	42.2	20.9	13.6	5.7	15.9	27.6	45.2	29.2	19.6	0	0
Fine Sand	%	17	46.8	27.1	38.5	15	7.8	3.6	15.2	26.7	36.5	22.8	12	39.8	32.3
Medium Sand	%	0.4	7.3	1.9	2.9	4.1	3.4	1.4	0.5	0.8	5	4.2	4.7	4.3	0.4
Course Sand	%	0.1	1.6	0	0.8	1.8	2.4	0.7	0.2	0.1	3.7	2.2	2.9	1	0
Gravel	%	0	1.1	0	0.6	0.3	3.5	1.5	0	0	2.3	17.2	2.2	0	0
Total Course Material [1]	%	17.5	56.8	29	42.8	21.2	17.1	7.2	15.9	27.6	47.5	46.4	21.8	0	0
Hydrometer Readings															
1, PE	% passing	69.5	41.3	69.5	53.5	74.6	77.7	86	73.9	62.3	50.7	36.8	72.5	48.4	42.7
2, PE	% passing	62.9	33.7	62.2	46.7	68.3	71.6	83	65.2	54.2	43.7	31.8	64.3	40.8	34.8
3, PE	% passing	42.9	26	50.1	37.5	58.2	62.4	73.9	51.5	42	34.4	24.8	53.3	32	25
4, PE	% passing	32.2	18.4	40.5	31.8	51.9	56.2	67.8	40.3	34.9	27.4	20.9	47.8	26.9	19.1
5, PE	% passing	25.5	14.5	33.2	26	48.3	51.6	60.2	34	28.8	20.4	16.9	41.2	21.9	15.1
6, PE	% passing	17.1	10.5	23.6	18	38.3	41	48.2	22.6	19.5	15.7	12.1	31.7	14.3	10.2
7, PE	% passing	12.2	6.9	16.3	12.3	28.8	30.2	37.6	15.4	12.5	10.9	9.4	25.5	9.3	7.2
Sieve Analysis															
SIEVE, NO. 200	% passing	82.6	43.2	71	57.2	78.7	82.9	92.8	84	72.4	52.5	53.6	78.2	55	67.3
SIEVE, NO. 100	% passing	93.1	54.9	87.2	80.3	86.5	85.9	94.2	92.8	85.3	65.1	61.4	83.4	68.8	88.2
SIEVE, NO. 80	% passing	95.2	59.1	90.7	84.7	87.9	87	94.8	94.7	89	70.5	64.7	84.7	74.5	92.1
SIEVE, NO. 60	% passing	98.6	75.5	95.9	92.3	91.3	88.7	95.5	98	96.3	82.5	72.1	87.8	86.5	97.7
SIEVE, NO. 40	% passing	99.6	90	98.1	95.7	93.8	90.7	96.4	99.2	99.1	89	76.4	90.2	94.8	99.6
SIEVE, NO. 20	% passing	99.8	94.7	99.1	97.3	96	92.2	97.1	99.6	99.7	91.7	78.8	92.2	97.6	99.9
SIEVE, NO. 10	% passing	99.9	97.3	100	98.6	97.9	94.1	97.8	99.8	99.9	94	80.6	94.9	99	100
SIEVE, NO. 4	% passing	100	98.9	100	99.4	99.7	96.5	98.5	100	100	97.7	82.8	97.8	100	100
SIEVE, 9500 MICRONS	% passing	100	100	100	100	100	100	100	100	100	100	84	100	100	100
SIEVE, 19000 MICRONS	% passing	100	100	100	100	100	100	100	100	100	100	100	100	100	100
SIEVE, 25000 MICRONS	% passing	100	100	100	100	100	100	100	100	100	100	100	100	100	100
SIEVE, 38000 MICRONS	% passing	100	100	100	100	100	100	100	100	100	100	100	100	100	100
SIEVE, 50000 MICRONS	% passing	100	100	100	100	100	100	100	100	100	100	100	100	100	100
SIEVE, 75000 MICRONS	% passing	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Notes:

[1] Percent of total course material equals the sum of total sand (fine, medium, course) and gravel.

Abbreviations:

g/cm^3 = grams per cubic centimeter

mg/kg = milligrams per kilogram

NP = Non-plastic

-- = Not analyzed

TABLE A1

Geotechnical Analytical Result Summary

Waukegan Harbor Area of Concern

Segment >>>		Marina													
Location Id >>>		Area D	WH-SD027	WH-SD027	WH-SD027	WH-SD027	WH-SD027	WH-SD027	WH-SD027	WH-SD032	WH-SD032	WH-SD032	WH-SD032	WH-SD032	WH-SD032
Sample Interval (ft) >>>		0 - 8	0 - 2	2 - 4	4 - 6	6 - 7	7 - 8	8 - 9	9 - 9.83	0 - 2	2 - 3	3 - 4	4 - 5	5- 6	6 - 7.25
Parameter Description	**Units**														
Bulk Density	g/cm^3	0.69	0.65	0.67	0.7	0.68	0.75	0.72	0.86	1.31	2.05	1.71	1.63	1.76	1.62
Liquid Limit	--	73	0	0	50	53	55	53	48	0	0	0	0	0	0
Percent Moisture	%	103.6	129.1	112.9	104.3	106.6	99.2	104.5	41.3	35	29.2	19.7	23	19.9	21.8
Percent Solids	%	48.1	--	--	--	--	--	--	--	--	--	--	--	--	--
Plastic Limit	--	38	0	0	0	0	0	0	0	0	0	0	0	0	0
Plasticity Index	--	35	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
Specific Gravity	--	2.634	2.65	2.63	2.62	2.6	2.6	2.6	2.58	2.61	2.64	2.72	2.64	2.69	2.69
Total Organic Carbon	mg/kg	42,200	--	--	--	--	--	--	--	--	--	--	--	--	--
Soil Classification															
Organic Matter		--	7	6	6.8	6.5	6.7	6.7	2.7	3.1	2.2	0.5	1.9	0.4	1.6
Clay	%	33.9	36.8	38.2	37.7	42.8	42.7	42	43.6	5.1	5.8	2.5	4.1	5	4.2
Silt	%	55	57	56.2	56.8	51.6	52.3	52.5	51.3	12.5	7.4	3	5.2	5.1	7
Total Sand	%	11.1	6.2	5.6	5.5	5.6	5	5.5	5.1	82.5	86.7	94.4	90.7	89.8	88.7
Fine Sand	%	10.6	6.2	5.6	5.5	5.6	5	5.5	5	80.3	83.2	88.9	86.7	87.8	86.3
Medium Sand	%	0.2	0	0	0	0	0	0	0.1	2	2.7	4.1	3.2	1.7	2
Course Sand	%	0.3	0	0	0	0	0	0	0	0.2	0.8	1.4	0.8	0.3	0.4
Gravel	%	0.1	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2
Total Course Material [1]	%	11.2	6.2	5.6	5.5	5.6	5	5.5	5.1	82.5	86.7	94.4	90.7	90	88.9
Hydrometer Readings															
1, PE	% passing	70.6	89	84.9	87.1	89.6	87.2	87.9	83.1	11.7	12.1	5.5	8.8	9.6	10.4
2, PE	% passing	59.8	75.8	74.3	73	76.6	78.3	79.2	72.7	9.8	9.8	4	7.3	7.3	7.3
3, PE	% passing	46.8	59.3	61.6	56.5	62.7	65	61.7	62.3	7.9	7.4	4	5.8	5.7	5
4, PE	% passing	38.2	46.1	48.8	44.7	51.9	53.8	50.7	51.9	7	6.6	3.2	4.1	5.7	4.2
5, PE	% passing	33.9	36.8	38.2	37.7	42.8	42.7	42	43.6	5.1	5.8	2.5	4.1	5	4.2
6, PE	% passing	20.7	27.5	28.3	26.7	29.9	31.9	29.2	29.8	5.1	5.3	2.5	3.8	4.5	3.7
7, PE	% passing	13.3	20.9	19.8	19.6	23.2	21.2	20.8	19.7	4	4.1	2.2	2.5	3.9	2.5
Sieve Analysis															
SIEVE, NO. 200	% passing	88.9	93.8	94.4	94.5	94.4	95	94.5	94.9	17.6	13.2	5.5	9.3	10	11.1
SIEVE, NO. 100	% passing	95.9	98.1	98.2	98.3	98	98.7	98.4	98.8	48.2	33.9	16.6	29.1	41.2	36.8
SIEVE, NO. 80	% passing	97	99	98.9	99.1	98.7	99.2	99	99.2	62.5	45.2	28.2	42.7	62.3	53
SIEVE, NO. 60	% passing	98.9	99.8	99.8	99.8	99.7	99.8	99.8	99.7	90.2	84	73.9	81.9	91.4	87.7
SIEVE, NO. 40	% passing	99.5	100	100	100	100	100	100	99.9	97.9	96.4	94.5	96	97.8	97.4
SIEVE, NO. 20	% passing	99.6	100	100	100	100	100	100	100	99.2	98.1	97.1	98	98.9	98.7
SIEVE, NO. 10	% passing	99.6	100	100	100	100	100	100	100	99.8	99.1	98.6	99.2	99.5	99.4
SIEVE, NO. 4	% passing	99.9	100	100	100	100	100	100	100	100	100	100	100	99.8	99.8
SIEVE, 9500 MICRONS	% passing	100	100	100	100	100	100	100	100	100	100	100	100	100	100
SIEVE, 19000 MICRONS	% passing	100	100	100	100	100	100	100	100	100	100	100	100	100	100
SIEVE, 25000 MICRONS	% passing	100	100	100	100	100	100	100	100	100	100	100	100	100	100
SIEVE, 38000 MICRONS	% passing	100	100	100	100	100	100	100	100	100	100	100	100	100	100
SIEVE, 50000 MICRONS	% passing	100	100	100	100	100	100	100	100	100	100	100	100	100	100
SIEVE, 75000 MICRONS	% passing	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Notes:

[1] Percent of total course material equals the sum of tot

Abbreviations:

g/cm^3 = grams per cubic centimeter

mg/kg = milligrams per kilogram

NP = Non-plastic

-- = Not analyzed

TABLE A1

Geotechnical Analytical Result Summary

Waukegan Harbor Area of Concern

Segment >>>		Entrance Channel									
Location Id >>>		Area C	WH-SD037	WH-SD037	WH-SD041	WH-SD041	WH-SD041	WH-SD041	WH-SD041	WH-SD041	WH-SD078
Sample Interval (ft) >>>		0 - 6	0 - 2	2 - 2.58	0 - 2	2 - 3	3 - 4	4 - 5	5- 6	6 - 6.75	0 - 2
Parameter Description	**Units**										
Bulk Density	g/cm^3	1.08	1.1	1.51	1.22	1.25	1.22	1.16	1.23	1.28	1.33
Liquid Limit	--	0	0	23	0	0	28	29	24	24	0
Percent Moisture	%	53.5	32.3	24.7	45.7	35.3	40.3	43.4	34.6	33.7	36.9
Percent Solids	%	70.8	--	--	--	--	--	--	--	--	76.1
Plastic Limit	--	0	0	16	0	0	0	0	0	0	0
Plasticity Index	--	NP	NP	8	NP	NP	NP	NP	NP	NP	NP
Specific Gravity	--	2.731	2.61	2.63	2.67	2.81	2.6	2.62	2.62	2.63	2.688
Total Organic Carbon	mg/kg	30,400	40,100	39,500	50,900	--	--	--	--	--	10,200
Soil Classification											
Organic Matter		--	2.6	2.1	2.4	1.9	2.6	2.7	2.9	5.3	--
Clay	%	11	11.6	20	14.8	14.1	19.3	21.2	16.6	24.1	9.0
Silt	%	55.1	42.8	25.6	64.1	47.8	58.4	59.8	51.1	44.1	22.8
Total Sand	%	33.9	45.4	30	21.2	38	22.3	18.9	32.1	30	0
Fine Sand	%	33.3	43.5	21.9	21	37.4	21.7	18.4	30.3	26.4	66.2
Medium Sand	%	0.5	1.8	4.4	0.2	0.4	0.6	0.5	1.5	2.7	1.3
Course Sand	%	0.1	0.1	3.7	0	0.2	0	0	0.3	0.9	0.2
Gravel	%	0	0.2	24.3	0	0	0	0	0.1	1.7	0.6
Total Course Material [1]	%	33.9	45.6	54.3	21.2	38	22.3	18.9	32.2	31.7	0
Hydrometer Readings											
1, PE	% passing	38.4	42	41.5	47.5	41.5	64.1	69	54.3	57	24.2
2, PE	% passing	28.1	30.1	37	36	31.3	52.5	55.5	45.1	49.1	19.9
3, PE	% passing	18.5	19.5	29.1	24.8	23.3	35.2	38.4	30.9	37.3	14.1
4, PE	% passing	13.7	14.2	23.4	17.7	18.7	25	27.4	22.7	29.4	10.4
5, PE	% passing	11	11.6	20	14.8	14.1	19.3	21.2	16.6	24.1	9.0
6, PE	% passing	10.2	8.9	15.5	11	10.9	15.4	14.3	10.9	16.7	6.8
7, PE	% passing	6.2	6.2	12	7.4	8.2	10.4	11.2	8.3	12.3	4.6
Sieve Analysis											
SIEVE, NO. 200	% passing	66.1	54.4	45.7	78.9	62	77.7	81	67.7	68.2	31.7
SIEVE, NO. 100	% passing	81.4	69.6	54	91.1	83.3	91	91	80.8	79.9	43.4
SIEVE, NO. 80	% passing	86.5	78.6	57.5	94.7	90.7	94.9	94.4	86.1	84.3	53.3
SIEVE, NO. 60	% passing	96.7	93.5	64.4	99	98.2	98.7	98.5	94.8	91.6	86.1
SIEVE, NO. 40	% passing	99.4	97.9	67.6	99.8	99.4	99.4	99.5	98	94.6	97.9
SIEVE, NO. 20	% passing	99.8	98.9	69.5	99.9	99.6	99.6	99.7	98.8	96	99.0
SIEVE, NO. 10	% passing	99.9	99.7	72	100	99.8	100	100	99.5	97.4	99.2
SIEVE, NO. 4	% passing	100	99.8	75.7	100	100	100	100	99.9	98.3	99.4
SIEVE, 9500 MICRONS	% passing	100	100	78.5	100	100	100	100	100	100	100
SIEVE, 19000 MICRONS	% passing	100	100	83.6	100	100	100	100	100	100	100
SIEVE, 25000 MICRONS	% passing	100	100	100	100	100	100	100	100	100	100
SIEVE, 38000 MICRONS	% passing	100	100	100	100	100	100	100	100	100	100
SIEVE, 50000 MICRONS	% passing	100	100	100	100	100	100	100	100	100	100
SIEVE, 75000 MICRONS	% passing	100	100	100	100	100	100	100	100	100	100

Notes:

[1] Percent of total course material equals the sum of tot

Abbreviations:

g/cm^3 = grams per cubic centimeter

mg/kg = milligrams per kilogram

NP = Non-plastic

-- = Not analyzed

TABLE A1

Geotechnical Analytical Result Summary

Waukegan Harbor Area of Concern

Segment >>>		Outer Harbor														
Location Id >>>		WH-SD046	WH-SD046	WH-SD046	WH-SD046	WH-SD046	WH-SD046	WH-SD046	WH-SD050	WH-SD050	WH-SD050	WH-SD050	WH-SD050	WH-SD050	WH-SD050	WH-SD050
Sample Interval (ft) >>>		0 - 2	4 - 5	5 - 6	6 - 8	8 - 9	9 - 10	10 - 10.92	0 - 2	2 - 4	4 - 6	6 - 7	7 - 8	8 - 9	9 - 10	10 - 11
Parameter Description	**Units**															
Bulk Density	g/cm^3	1.71	1.55	1.73	1.79	1.65	1.6	1.79	1.71	1.48	1.54	1.36	1.64	1.87	2.19	2.11
Liquid Limit	--	0	0	0	0	0	0	0	0	0	0	0	0	0	20	18
Percent Moisture	%	23	26.1	20.4	19.5	23.8	26.8	20.8	22.5	20.7	27.6	25.6	21.8	20.6	12.1	12.6
Percent Solids	%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Plastic Limit	--	0	0	0	0	0	0	0	0	0	0	0	0	0	13	13
Plasticity Index	--	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	7	5
Specific Gravity	--	2.73	2.71	2.72	2.69	2.7	2.71	2.73	2.61	2.68	2.63	2.64	2.71	2.76	2.82	2.74
Total Organic Carbon	mg/kg	--	--	--	13,300	--	--	--	14,700	40,300	--	44,300	26,500	--	--	--
Soil Classification																
Organic Matter		1.1	1.5	0.7	0.7	1.6	1.6	1.5	1.2	1.1	3	3.2	0.8	0.8	1.6	1.3
Clay	%	5.7	8.9	4.3	6.7	10.5	14	10.8	4.5	4.7	8.7	10.2	4.5	6.2	25.1	21.5
Silt	%	51.2	53.4	14.2	34.4	36.2	43.4	17.3	34	34.2	43.9	53.4	22.5	23.7	28.7	25.8
Total Sand	%	43	37.7	81.4	58.7	53.3	42.5	27	61.5	61.1	47.2	36.4	73.1	51.1	29.7	37
Fine Sand	%	42.6	37.3	81.1	57.9	52.8	42.4	22.9	61.1	60.7	46	35.2	73	47.9	15.5	26.7
Medium Sand	%	0.4	0.3	0.3	0.6	0.4	0.1	2.1	0.4	0.4	1.1	1.2	0.1	1.6	9	7
Course Sand	%	0	0.1	0	0.2	0.1	0	2	0	0	0.1	0	0	1.6	5.2	3.3
Gravel	%	0	0	0	0.2	0	0	44.9	0	0	0.3	0	0	19	16.5	15.7
Total Course Material [1]	%	43	37.7	81.4	58.9	53.3	42.5	71.9	61.5	61.1	47.5	36.4	73.1	70.1	46.2	52.7
Hydrometer Readings																
1, PE	% passing	26.1	32.3	10.3	23.9	33.4	36.4	26.1	20.7	22.6	36.5	37.7	9.9	18.5	44.9	38.7
2, PE	% passing	18.4	23.4	7.9	17	24.7	31.4	20.7	12.2	15.6	25.9	28.5	7.9	14.2	39.9	33.7
3, PE	% passing	10.8	15.2	6	10.2	17.5	21.4	15.4	8.3	9.6	15.9	18.8	5.8	9.9	33.9	27.6
4, PE	% passing	7.6	10.8	4.8	8.1	13.5	17.8	13.1	5.2	6.4	11.3	13	5.1	7.4	29.1	23.5
5, PE	% passing	5.7	8.9	4.3	6.7	10.5	14	10.8	4.5	4.7	8.7	10.2	4.5	6.2	25.1	21.5
6, PE	% passing	4.7	7.2	3.8	5.3	9	11.7	9.4	3.7	3.7	6.9	7.3	3.2	4.5	19.3	15.6
7, PE	% passing	4	5.9	3.2	3.9	6.6	9.2	7.1	2.8	3.1	5.1	5	3.1	3.5	13.6	10.8
Sieve Analysis																
SIEVE, NO. 200	% passing	56.9	62.3	18.6	41.1	46.6	57.5	28.1	38.5	38.9	52.6	63.5	26.9	29.9	53.8	47.3
SIEVE, NO. 100	% passing	80.8	85.9	72.1	78	81.2	97.4	44.3	67.2	68.6	77.1	85.6	98.4	71.4	61.1	61
SIEVE, NO. 80	% passing	88.7	92.8	87.3	88.2	90.7	98.6	47.2	80.3	81	86.1	91.5	98.9	73.6	62.3	64.5
SIEVE, NO. 60	% passing	97.5	98.4	97.9	97.6	98.1	99.6	49.9	96.9	97.5	96.7	97.6	99.5	76.6	65.3	70
SIEVE, NO. 40	% passing	99.6	99.6	99.7	99.1	99.5	99.9	51.1	99.6	99.6	98.5	98.8	99.9	77.7	69.3	74
SIEVE, NO. 20	% passing	99.9	99.8	99.9	99.4	99.7	100	52.1	99.9	99.9	99.1	99.4	100	78.4	73.3	77.2
SIEVE, NO. 10	% passing	100	99.9	100	99.7	99.9	100	53.1	100	100	99.6	100	100	79.3	78.3	81
SIEVE, NO. 4	% passing	100	100	100	99.8	100	100	55.1	100	100	99.7	100	100	81	83.5	84.3
SIEVE, 9500 MICRONS	% passing	100	100	100	100	100	100	59.4	100	100	100	100	100	85.4	100	87.2
SIEVE, 19000 MICRONS	% passing	100	100	100	100	100	100	59.4	100	100	100	100	100	100	100	100
SIEVE, 25000 MICRONS	% passing	100	100	100	100	100	100	76.8	100	100	100	100	100	100	100	100
SIEVE, 38000 MICRONS	% passing	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
SIEVE, 50000 MICRONS	% passing	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
SIEVE, 75000 MICRONS	% passing	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Notes:

[1] Percent of total course material equals the sum of tot

Abbreviations:

g/cm^3 = grams per cubic centimeter

mg/kg = milligrams per kilogram

NP = Non-plastic

-- = Not analyzed

TABLE B-1

Summary of Total PCB Results Used in Feasibily Study

Waukegan Harbor RI

Location	Sample ID	X Coordinate [1]	Y Coordinate [1]	Top of Sediment Elevation (lwd IGLD85)	Sample Mid-point Depth (ft)	Sample Mid-point Elevation [2] (IGLD85)	Total PCB (ppm) [3]
Slip 4							
WH-SD001	WH-SD001-00_04	1123086.500	2076839.200	-8.353	-0.15	-8.50	0.316 (ND)
WH-SD001	WH-SD001-04_16	1123086.500	2076839.200	-8.353	-0.80	-9.15	0.301 (ND)
WH-SD001	WH-SD001-16_28	1123086.500	2076839.200	-8.353	-1.65	-10.00	0.127 (ND)
WH-SD001	WH-SD001-28_40	1123086.500	2076839.200	-8.353	-2.50	-10.85	0.121 (ND)
WH-SD001	WH-SD001-40_52	1123086.500	2076839.200	-8.353	-3.75	-12.10	0.127 (ND)
WH-SD001	WH-SD001-52_64	1123086.500	2076839.200	-8.353	-5.15	-13.50	0.123 (ND)
WH-SD001	WH-SD001-64_76	1123086.500	2076839.200	-8.353	-6.30	-14.65	0.123 (ND)
WH-SD001	WH-SD001-76_88	1123086.500	2076839.200	-8.353	-7.50	-15.85	0.130 (ND)
WH-SD001	WH-SD001-88_100	1123086.500	2076839.200	-8.353	-8.95	-17.30	0.112 (ND)
WH-SD001	WH-SD001-100_106	1123086.500	2076839.200	-8.353	-9.95	-18.30	0.112 (ND)
WH-SD002	WH-SD002-00_04	1122872.620	2076814.960	-11.007	-0.15	-11.16	0.414
WH-SD002	WH-SD002-04_16	1122872.620	2076814.960	-11.007	-0.80	-11.81	0.453
WH-SD002	WH-SD002-16_28	1122872.620	2076814.960	-11.007	-2.15	-13.16	0.239
WH-SD002	WH-SD002-28_40	1122872.620	2076814.960	-11.007	-3.90	-14.91	0.384
WH-SD002	WH-SD002-40_52	1122872.620	2076814.960	-11.007	-5.30	-16.31	0.356
WH-SD002	WH-SD002-52_64	1122872.620	2076814.960	-11.007	-6.35	-17.36	0.124 (ND)
WH-SD002	WH-SD002-64_71	1122872.620	2076814.960	-11.007	-7.20	-18.21	0.124 (ND)
WH-SD002	WH-SD002-71_78	1122872.620	2076814.960	-11.007	-7.80	-18.81	0.112 (ND)
North Harbor							
WH-13A	WH-2002-13.3	1122403.000	2075936.000	-15.432	-0.42	-15.85	0.285
WH-14	WH-2002-14.1	1122491.000	2076271.000	-17.176	-0.04	-17.22	7.062
WH-14	WH-2002-14.3	1122491.000	2076271.000	-17.176	-0.75	-17.93	0.190
WH-15	WH-2002-15.1	1122609.000	2076585.000	-18.157	-0.17	-18.33	2.488
WH-15	WH-2002-15.3	1122609.000	2076585.000	-18.157	-0.67	-18.83	0.140 (ND)
WH-SD003	WH-SD003-00_12	1122676.900	2076755.800	-17.876	-0.50	-18.38	1.297
WH-SD003	WH-SD003-12_24	1122676.900	2076755.800	-17.876	-1.50	-19.38	21.980
WH-SD003	WH-SD003-24_36	1122676.900	2076755.800	-17.876	-2.50	-20.38	0.395
WH-SD003	WH-SD003-36_48	1122676.900	2076755.800	-17.876	-3.40	-21.28	0.145 (ND)
WH-SD003	WH-SD003-48_60	1122676.900	2076755.800	-17.876	-4.30	-22.18	0.118
WH-SD004	WH-SD004-00_12	1122576.300	2076595.100	-17.804	-0.50	-18.30	5.900

TABLE B-1

Summary of Total PCB Results Used in Feasibily Study

Waukegan Harbor RI

Location	Sample ID	X Coordinate [1]	Y Coordinate [1]	Top of Sediment Elevation (lwd IGLD85)	Sample Mid-point Depth (ft)	Sample Mid-point Elevation [2] (IGLD85)	Total PCB (ppm) [3]
WH-SD004	WH-SD004-12_24	1122576.300	2076595.100	-17.804	-1.50	-19.30	26.900
WH-SD004	WH-SD004-24_36	1122576.300	2076595.100	-17.804	-2.40	-20.20	13.735
WH-SD004	WH-SD004-36_48	1122576.300	2076595.100	-17.804	-3.15	-20.95	0.132
WH-SD005	WH-SD005-00_12	1122651.700	2076387.600	-17.982	-0.50	-18.48	6.052
WH-SD005	WH-SD005-12_24	1122651.700	2076387.600	-17.982	-1.50	-19.48	21.230
WH-SD005	WH-SD005-24_36	1122651.700	2076387.600	-17.982	-2.55	-20.53	15.130
WH-SD005	WH-SD005-36_48	1122651.700	2076387.600	-17.982	-3.60	-21.58	0.276
WH-SD006	WH-SD006-00_24	1122542.700	2076173.700	-18.856	-1.00	-19.86	2.375
WH-SD006	WH-SD006-24_39	1122542.700	2076173.700	-18.856	-2.60	-21.46	1.475
WH-SD006	WH-SD006-39_51	1122542.700	2076173.700	-18.856	-3.70	-22.56	0.116
WH-SD007	WH-SD007-00_12	1122436.900	2075962.800	-18.319	-0.50	-18.82	3.403
WH-SD007	WH-SD007-12_24	1122436.900	2075962.800	-18.319	-1.50	-19.82	3.636
WH-SD007	WH-SD007-24_38	1122436.900	2075962.800	-18.319	-2.60	-20.92	5.123
WH-SD007	WH-SD007-38_50	1122436.900	2075962.800	-18.319	-3.70	-22.02	0.152
WH-SD008	WH-SD008-00_12	1122518.200	2075743.800	-17.952	-0.50	-18.45	0.118 (ND)
WH-SD054	WH-SD054-00_12	1122710.900	2076705.700	-17.534	-0.50	-18.03	1.041
WH-SD054	WH-SD054-12_24	1122710.900	2076705.700	-17.534	-1.50	-19.03	2.936
WH-SD054	WH-SD054-24_36	1122710.900	2076705.700	-17.534	-2.50	-20.03	18.105
WH-SD054	WH-SD054-36_48	1122710.900	2076705.700	-17.534	-3.50	-21.03	16.360
WH-SD054	WH-SD054-48_60	1122710.900	2076705.700	-17.534	-4.75	-22.28	0.174 (ND)
WH-SD054	WH-SD054-60_72	1122710.900	2076705.700	-17.534	-6.00	-23.53	0.121 (ND)
WH-SD055	WH-SD055-00_12	1122400.900	2075779.500	-20.531	-0.50	-21.03	0.115 (ND)
WH-SD060	WH-SD060-0.0/1.0	1122666.966	2076750.065	-17.82	-0.50	-18.32	2.035
WH-SD060	WH-SD060-1.0/2.0	1122666.966	2076750.065	-17.82	-1.50	-19.32	0.155 (ND)
WH-SD060	WH-SD060-2.0/2.7	1122666.966	2076750.065	-17.82	-2.35	-20.17	0.105 (ND)
WH-SD061	WH-SD061-0.0/1.0	1122699.001	2076603.435	-17.58	-0.50	-18.08	0.99
WH-SD061	WH-SD061-1.0/2.0	1122699.001	2076603.435	-17.58	-1.50	-19.08	2.388
WH-SD061	WH-SD061-2.0/3.2	1122699.001	2076603.435	-17.58	-2.60	-20.18	2.416
WH-SD062	WH-SD062-0.0/1.0	1122533.394	2076394.173	-18.31	-0.50	-18.81	4.5605
WH-SD062	WH-SD062-1.0/1.7	1122533.394	2076394.173	-18.31	-1.35	-19.66	13.6765
WH-SD063	WH-SD063-0.0/2.0	1122391.313	2076156.796	-15.65	-1.00	-16.65	7.204

TABLE B-1

Summary of Total PCB Results Used in Feasibily Study

Waukegan Harbor RI

Location	Sample ID	X Coordinate [1]	Y Coordinate [1]	Top of Sediment Elevation (lwd IGLD85)	Sample Mid-point Depth (ft)	Sample Mid-point Elevation [2] (IGLD85)	Total PCB (ppm) [3]
WH-SD064	WH-SD064-0.0/1.0	1122583.294	2075922.504	-16.88	-0.50	-17.38	0.518
Slip 1							
WH-SD065	WH-SD065-0.0/0.5	1121658.033	2076075.867	-22.22	-0.25	-22.47	16.6765
WH-SD066	WH-SD066-0.0/0.5	1121679.352	2075945.524	-18.59	-0.25	-18.84	2.318
WH-SD067	WH-SD067-0.0/0.5	1121760.488	2075890.979	-18.18	-0.25	-18.43	1.761
WH-SD068	WH-SD068-0.0/0.5	1121927.453	2075855.899	-19.95	-0.25	-20.20	2.0725
WH-SD011	WH-SD011-00_04	1121793.500	2075949.900	-19.136	-0.25	-19.39	4.327
WH-SD012	WH-SD012-00_04	1121894.500	2075738.100	-19.289	-0.15	-19.44	0.511
Inner Harbor Extension							
WH-10	WH-2002-10.1	1122113.000	2075499.000	-19.612	-0.17	-19.78	1.727
WH-10	WH-2002-10.3	1122113.000	2075499.000	-19.612	-1.00	-20.61	0.207
WH-SD009	WH-SD009-00_12	1122314.700	2075749.900	-17.730	-0.50	-18.23	0.112 (ND)
WH-SD010	WH-SD010-00_12	1122130.200	2075726.900	-20.925	-0.50	-21.43	0.416
WH-SD013	WH-SD013-00_12	1122046.700	2075584.900	-20.307	-0.50	-20.81	0.112 (ND)
WH-SD014	WH-SD014-00_12	1122301.400	2075622.400	-21.180	-0.50	-21.68	0.115 (ND)
WH-SD015	WH-SD015-00_12	1122447.500	2075547.900	-12.487	-0.50	-12.99	0.136
WH-SD015	WH-SD015-12_24	1122447.500	2075547.900	-12.487	-1.50	-13.99	4.403
WH-SD015	WH-SD015-24_36	1122447.500	2075547.900	-12.487	-2.50	-14.99	9.270
WH-SD015	WH-SD015-36_48	1122447.500	2075547.900	-12.487	-3.50	-15.99	6.025
WH-SD015	WH-SD015-48_60	1122447.500	2075547.900	-12.487	-4.50	-16.99	1.903
WH-SD015	WH-SD015-60_72	1122447.500	2075547.900	-12.487	-5.50	-17.99	0.117 (ND)
WH-SD015	WH-SD015-72_84	1122447.500	2075547.900	-12.487	-6.50	-18.99	0.121 (ND)
WH-SD015	WH-SD015-84_96	1122447.500	2075547.900	-12.487	-7.65	-20.14	2.803
WH-SD015	WH-SD015-100_112	1122447.500	2075547.900	-12.487	-8.80	-21.29	0.109 (ND)
Inner Harbor							
WH-07	WH-2002-7.1	1122659.000	2074601.000	-17.632	-0.92	-18.55	15.045
WH-07	WH-2002-7.2	1122659.000	2074601.000	-17.632	-2.83	-20.46	6.010
WH-07	WH-2002-7.3	1122659.000	2074601.000	-17.632	-3.71	-21.34	0.236
WH-08	WH-2002-8.1	1122370.000	2075136.000	-20.414	-0.41	-20.82	7.956
WH-08	WH-2002-8.3	1122370.000	2075136.000	-20.414	-1.58	-21.99	0.184
WH-09	WH-2002-9.1	1122084.000	2075246.000	-15.728	-1.75	-17.48	32.298

TABLE B-1

Summary of Total PCB Results Used in Feasibily Study

Waukegan Harbor RI

Location	Sample ID	X Coordinate [1]	Y Coordinate [1]	Top of Sediment Elevation (lwd IGLD85)	Sample Mid-point Depth (ft)	Sample Mid-point Elevation [2] (IGLD85)	Total PCB (ppm) [3]
WH-09	WH-2002-9.2	1122084.000	2075246.000	-15.728	-4.41	-20.14	25.333
WH-09	WH-2002-9.3	1122084.000	2075246.000	-15.728	-5.08	-20.81	0.311
WH-SD016	WH-SD016-00_12	1122119.200	2075278.300	-18.530	-0.50	-19.03	2.450
WH-SD016	WH-SD016-12_24	1122119.200	2075278.300	-18.530	-1.50	-20.03	2.764
WH-SD016	WH-SD016-24_36	1122119.200	2075278.300	-18.530	-2.50	-21.03	6.552
WH-SD016	WH-SD016-36_48	1122119.200	2075278.300	-18.530	-3.50	-22.03	4.760
WH-SD016	WH-SD016-48_60	1122119.200	2075278.300	-18.530	-4.50	-23.03	2.658
WH-SD016	WH-SD016-60_72	1122119.200	2075278.300	-18.530	-5.50	-24.03	5.364
WH-SD016	WH-SD016-72_84	1122119.200	2075278.300	-18.530	-6.50	-25.03	14.835
WH-SD017	WH-SD017-00_12	1122330.500	2075303.600	-19.005	-0.50	-19.51	4.436
WH-SD017	WH-SD017-12_24	1122330.500	2075303.600	-19.005	-1.50	-20.51	2.996
WH-SD017	WH-SD017-24_35	1122330.500	2075303.600	-19.005	-2.45	-21.46	2.875
WH-SD018	WH-SD018-00_12	1122217.200	2075079.000	-20.944	-0.50	-21.44	1.833
WH-SD018	WH-SD018-12_22	1122217.200	2075079.000	-20.944	-1.40	-22.34	0.460
WH-SD019	WH-SD019-00_24	1122424.800	2075072.500	-18.572	-1.00	-19.57	1.799
WH-SD019	WH-SD019-24_32	1122424.800	2075072.500	-18.572	-2.50	-21.07	1.181
WH-SD020	WH-SD020-00_12	1122120.700	2074960.200	-13.309	-0.50	-13.81	1.159
WH-SD020	WH-SD020-12_24	1122120.700	2074960.200	-13.309	-1.50	-14.81	1.785
WH-SD020	WH-SD020-24_36	1122120.700	2074960.200	-13.309	-2.50	-15.81	2.188
WH-SD020	WH-SD020-36_48	1122120.700	2074960.200	-13.309	-3.50	-16.81	6.697
WH-SD020	WH-SD020-48_60	1122120.700	2074960.200	-13.309	-4.50	-17.81	4.689
WH-SD020	WH-SD020-60_72	1122120.700	2074960.200	-13.309	-5.50	-18.81	7.477
WH-SD020	WH-SD020-72_84	1122120.700	2074960.200	-13.309	-6.50	-19.81	4.586
WH-SD020	WH-SD020-84_96	1122120.700	2074960.200	-13.309	-7.50	-20.81	5.499
WH-SD020	WH-SD020-96_108	1122120.700	2074960.200	-13.309	-8.50	-21.81	5.971
WH-SD020	WH-SD020-108_120	1122120.700	2074960.200	-13.309	-9.50	-22.81	3.697
WH-SD020	WH-SD020-120_136	1122120.700	2074960.200	-13.309	-10.75	-24.06	0.302
WH-SD023	WH-SD023-00_06	1122326.700	2074872.500	-21.249	-0.25	-21.50	2.650
WH-SD023	WH-SD023-06_12	1122326.700	2074872.500	-21.249	-0.75	-22.00	0.611
WH-SD023	WH-SD023-12_18	1122326.700	2074872.500	-21.249	-1.25	-22.50	0.720
WH-SD023	WH-SD023-18_24	1122326.700	2074872.500	-21.249	-1.75	-23.00	0.201

TABLE B-1

Summary of Total PCB Results Used in Feasibily Study

Waukegan Harbor RI

Location	Sample ID	X Coordinate [1]	Y Coordinate [1]	Top of Sediment Elevation (lwd IGLD85)	Sample Mid-point Depth (ft)	Sample Mid-point Elevation [2] (IGLD85)	Total PCB (ppm) [3]
WH-SD023	WH-SD023-24_34	1122326.700	2074872.500	-21.249	-2.40	-23.65	0.181
WH-SD024	WH-SD024-00_06	1122549.600	2074850.200	-21.107	-0.25	-21.36	2.349
WH-SD024	WH-SD024-06_12	1122549.600	2074850.200	-21.107	-0.75	-21.86	17.515
WH-SD024	WH-SD024-12_18	1122549.600	2074850.200	-21.107	-1.25	-22.36	21.470
WH-SD024	WH-SD024-18_24	1122549.600	2074850.200	-21.107	-1.75	-22.86	7.150
WH-SD025	WH-SD025-00_12	1122263.700	2074772.700	-12.770	-0.50	-13.27	2.875
WH-SD025	WH-SD025-12_24	1122263.700	2074772.700	-12.770	-1.50	-14.27	2.071
WH-SD025	WH-SD025-24_36	1122263.700	2074772.700	-12.770	-2.50	-15.27	1.171
WH-SD025	WH-SD025-36_48	1122263.700	2074772.700	-12.770	-3.50	-16.27	0.931
WH-SD025	WH-SD025-48_60	1122263.700	2074772.700	-12.770	-4.50	-17.27	2.274
WH-SD025	WH-SD025-60_72	1122263.700	2074772.700	-12.770	-5.50	-18.27	2.864
WH-SD025	WH-SD025-72_84	1122263.700	2074772.700	-12.770	-6.50	-19.27	1.504
WH-SD025	WH-SD025-84_96	1122263.700	2074772.700	-12.770	-7.50	-20.27	2.075
WH-SD025	WH-SD025-96_108	1122263.700	2074772.700	-12.770	-8.50	-21.27	2.083
WH-SD025	WH-SD025-108_120	1122263.700	2074772.700	-12.770	-9.50	-22.27	6.675
WH-SD025	WH-SD025-120_132	1122263.700	2074772.700	-12.770	-10.50	-23.27	3.364
WH-SD025	WH-SD025-132_144	1122263.700	2074772.700	-12.770	-11.50	-24.27	4.763
WH-SD025	WH-SD025-144_154	1122263.700	2074772.700	-12.770	-12.40	-25.17	2.336
WH-SD028	WH-SD028-00_12	1122449.700	2074648.900	-14.785	-0.50	-15.29	3.260
WH-SD028	WH-SD028-12_24	1122449.700	2074648.900	-14.785	-1.50	-16.29	4.363
WH-SD028	WH-SD028-24_36	1122449.700	2074648.900	-14.785	-2.50	-17.29	9.605
WH-SD028	WH-SD028-36_48	1122449.700	2074648.900	-14.785	-3.50	-18.29	5.558
WH-SD028	WH-SD028-48_60	1122449.700	2074648.900	-14.785	-4.50	-19.29	1.763
WH-SD028	WH-SD028-60_72	1122449.700	2074648.900	-14.785	-5.50	-20.29	4.464
WH-SD028	WH-SD028-72_90	1122449.700	2074648.900	-14.785	-6.75	-21.54	8.374
WH-SD028	WH-SD028-90_102	1122449.700	2074648.900	-14.785	-8.00	-22.79	4.960
WH-SD028	WH-SD028-102_114	1122449.700	2074648.900	-14.785	-9.00	-23.79	9.263
WH-SD028	WH-SD028-114_126	1122449.700	2074648.900	-14.785	-10.00	-24.79	8.858
WH-SD028	WH-SD028-126_138	1122449.700	2074648.900	-14.785	-10.95	-25.74	14.300
WH-SD028	WH-SD028-138_150	1122449.700	2074648.900	-14.785	-11.90	-26.69	7.338
WH-SD029	WH-SD029-00_07	1122646.600	2074657.800	-22.624	-0.25	-22.87	4.420

TABLE B-1

Summary of Total PCB Results Used in Feasibily Study

Waukegan Harbor RI

Location	Sample ID	X Coordinate [1]	Y Coordinate [1]	Top of Sediment Elevation (lwd IGLD85)	Sample Mid-point Depth (ft)	Sample Mid-point Elevation [2] (IGLD85)	Total PCB (ppm) [3]
WH-SD034	WH-SD034-00_04	1122875.900	2074650.400	-22.749	-0.15	-22.90	0.425
WH-SD056	WH-SD056-00_12	1122145.200	2075244.600	-19.325	-0.50	-19.83	2.864
WH-SD056	WH-SD056-12_24	1122145.200	2075244.600	-19.325	-1.50	-20.83	5.035
WH-SD056	WH-SD056-24_36	1122145.200	2075244.600	-19.325	-2.50	-21.83	5.175
WH-SD056	WH-SD056-36_48	1122145.200	2075244.600	-19.325	-3.50	-22.83	2.358
WH-SD056	WH-SD056-48_58	1122145.200	2075244.600	-19.325	-4.45	-23.78	0.419
WH-SD069	WH-SD069-0.0/1.0	1122400.813	2075440.125	-15.18	-0.50	-15.68	2.946
WH-SD069	WH-SD069-1.0/2.0	1122400.813	2075440.125	-15.18	-1.50	-16.68	0.334
WH-SD069	WH-SD069-2.0/3.0	1122400.813	2075440.125	-15.18	-2.50	-17.68	0.218
WH-SD069	WH-SD069-3.0/4.0	1122400.813	2075440.125	-15.18	-3.50	-18.68	0.492
WH-SD069	WH-SD069-4.0/5.0	1122400.813	2075440.125	-15.18	-4.50	-19.68	0.872
WH-SD069	WH-SD069-5.0/6.0	1122400.813	2075440.125	-15.18	-5.50	-20.68	0.32
WH-SD070	WH-SD070-0.0/1.0	1122038.079	2075356.851	-14.70	-0.50	-15.20	1.5185
WH-SD070	WH-SD070-1.0/2.0	1122038.079	2075356.851	-14.70	-1.50	-16.20	1.3095
WH-SD070	WH-SD070-2.0/3.0	1122038.079	2075356.851	-14.70	-2.50	-17.20	1.51
WH-SD070	WH-SD070-3.0/4.0	1122038.079	2075356.851	-14.70	-3.50	-18.20	6.029
WH-SD070	WH-SD070-4.0/5.0	1122038.079	2075356.851	-14.70	-4.50	-19.20	1.771
WH-SD070	WH-SD070-5.0/6.0	1122038.079	2075356.851	-14.70	-5.50	-20.20	3.756
WH-SD070	WH-SD070-6.0/7.1	1122038.079	2075356.851	-14.70	-6.55	-21.25	5.3685
WH-SD071	WH-SD071-0.0/1.0	1122040.518	2075091.751	-13.61	-0.50	-14.11	1.361
WH-SD071	WH-SD071-1.0/2.0	1122040.518	2075091.751	-13.61	-1.50	-15.11	1.3785
WH-SD071	WH-SD071-2.0/3.0	1122040.518	2075091.751	-13.61	-2.50	-16.11	2.3805
WH-SD071	WH-SD071-3.0/4.0	1122040.518	2075091.751	-13.61	-3.50	-17.11	0.5855
WH-SD071	WH-SD071-4.0/5.0	1122040.518	2075091.751	-13.61	-4.50	-18.11	0.5665
WH-SD071	WH-SD071-5.0/6.0	1122040.518	2075091.751	-13.61	-5.50	-19.11	0.6595
WH-SD071	WH-SD071-6.0/7.2	1122040.518	2075091.751	-13.61	-6.60	-20.21	0.7575
WH-SD072	WH-SD072-0.0/1.0	1122545.886	2074954.942	-15.77	-0.50	-16.27	0.157
WH-SD072	WH-SD072-1.0/2.0	1122545.886	2074954.942	-15.77	-1.50	-17.27	0.378
WH-SD072	WH-SD072-2.0/3.0	1122545.886	2074954.942	-15.77	-2.50	-18.27	0.189
WH-SD072	WH-SD072-3.0/4.0	1122545.886	2074954.942	-15.77	-3.50	-19.27	0.169
WH-SD072	WH-SD072-4.0/5.4	1122545.886	2074954.942	-15.77	-4.70	-20.47	0.224

TABLE B-1

Summary of Total PCB Results Used in Feasibily Study

Waukegan Harbor RI

Location	Sample ID	X Coordinate [1]	Y Coordinate [1]	Top of Sediment Elevation (lwd IGLD85)	Sample Mid-point Depth (ft)	Sample Mid-point Elevation [2] (IGLD85)	Total PCB (ppm) [3]
WH-SD072	WH-SD072-5.4/6.0	1122545.886	2074954.942	-15.77	-5.70	-21.47	0.222
WH-SD073	WH-SD073-0.0/1.0	1122755.802	2074765.641	-16.38	-0.50	-16.88	0.125
WH-SD073	WH-SD073-1.0/2.0	1122755.802	2074765.641	-16.38	-1.50	-17.88	0.131
WH-SD073	WH-SD073-2.0/3.0	1122755.802	2074765.641	-16.38	-2.50	-18.88	0.21
WH-SD073	WH-SD073-3.0/4.1	1122755.802	2074765.641	-16.38	-3.55	-19.93	0.143
WH-SD073	WH-SD073-4.1/5.0	1122755.802	2074765.641	-16.38	-4.55	-20.93	0.386
WH-SD073	WH-SD073-5.0/6.2	1122755.802	2074765.641	-16.38	-5.60	-21.98	0.266
WH-SD074	WH-SD074-0.0/1.0	1122618.137	2074506.025	-11.55	-0.50	-12.05	0.9155
WH-SD074	WH-SD074-1.0/2.0	1122618.137	2074506.025	-11.55	-1.50	-13.05	0.6255
WH-SD074	WH-SD074-2.0/3.0	1122618.137	2074506.025	-11.55	-2.50	-14.05	0.9635
WH-SD074	WH-SD074-3.0/4.0	1122618.137	2074506.025	-11.55	-3.50	-15.05	2.0395
WH-SD074	WH-SD074-4.0/5.0	1122618.137	2074506.025	-11.55	-4.50	-16.05	3.6525
WH-SD074	WH-SD074-5.0/6.0	1122618.137	2074506.025	-11.55	-5.50	-17.05	2.2505
WH-SD074	WH-SD074-6.0/7.0	1122618.137	2074506.025	-11.55	-6.50	-18.05	15.2435
WH-SD074	WH-SD074-7.0/8.0	1122618.137	2074506.025	-11.55	-7.50	-19.05	11.3435
WH-SD074	WH-SD074-8.0/9.0	1122618.137	2074506.025	-11.55	-8.50	-20.05	17.748
WH-SD074	WH-SD074-9.0/10.0	1122618.137	2074506.025	-11.55	-9.50	-21.05	3.542
WH-SD074	WH-SD074-10.0/11.0	1122618.137	2074506.025	-11.55	-10.50	-22.05	0.1015 (ND)
WH-SD074	WH-SD074-11.0/12.0	1122618.137	2074506.025	-11.55	-11.50	-23.05	0.0945 (ND)
WH-SD074	WH-SD074-12.0/12.4	1122618.137	2074506.025	-11.55	-12.20	-23.75	0.098 (ND)
Marina							
WH-SD021	WH-SD021-00_04	1121954.800	2074850.100	-7.625	-0.15	-7.78	0.821
WH-SD021	WH-SD021-04_16	1121954.800	2074850.100	-7.625	-0.80	-8.43	0.413
WH-SD021	WH-SD021-16_28	1121954.800	2074850.100	-7.625	-1.80	-9.43	0.242
WH-SD021	WH-SD021-28_40	1121954.800	2074850.100	-7.625	-2.80	-10.43	0.277
WH-SD021	WH-SD021-40_52	1121954.800	2074850.100	-7.625	-3.80	-11.43	0.447
WH-SD021	WH-SD021-52_64	1121954.800	2074850.100	-7.625	-4.80	-12.43	0.254
WH-SD021	WH-SD021-64_80	1121954.800	2074850.100	-7.625	-6.00	-13.63	0.124 (ND)
WH-SD022	WH-SD022-00_04	1122106.300	2074875.800	-10.872	-0.15	-11.02	2.074
WH-SD022	WH-SD022-04_10	1122106.300	2074875.800	-10.872	-0.55	-11.42	2.660
WH-SD022	WH-SD022-10_16	1122106.300	2074875.800	-10.872	-1.05	-11.92	3.163

TABLE B-1

Summary of Total PCB Results Used in Feasibily Study

Waukegan Harbor RI

Location	Sample ID	X Coordinate [1]	Y Coordinate [1]	Top of Sediment Elevation (lwd IGLD85)	Sample Mid-point Depth (ft)	Sample Mid-point Elevation [2] (IGLD85)	Total PCB (ppm) [3]
WH-SD022	WH-SD022-16_22	1122106.300	2074875.800	-10.872	-1.55	-12.42	2.963
WH-SD022	WH-SD022-22_28	1122106.300	2074875.800	-10.872	-2.05	-12.92	2.960
WH-SD022	WH-SD022-28_34	1122106.300	2074875.800	-10.872	-2.55	-13.42	2.461
WH-SD022	WH-SD022-34_40	1122106.300	2074875.800	-10.872	-3.05	-13.92	3.171
WH-SD022	WH-SD022-40_46	1122106.300	2074875.800	-10.872	-3.55	-14.42	2.361
WH-SD022	WH-SD022-46_52	1122106.300	2074875.800	-10.872	-4.05	-14.92	2.772
WH-SD022	WH-SD022-52_58	1122106.300	2074875.800	-10.872	-4.55	-15.42	3.861
WH-SD022	WH-SD022-58_64	1122106.300	2074875.800	-10.872	-5.05	-15.92	6.075
WH-SD022	WH-SD022-64_70	1122106.300	2074875.800	-10.872	-5.55	-16.42	5.686
WH-SD022	WH-SD022-70_76	1122106.300	2074875.800	-10.872	-6.05	-16.92	4.064
WH-SD022	WH-SD022-76_82	1122106.300	2074875.800	-10.872	-6.55	-17.42	4.274
WH-SD022	WH-SD022-82_88	1122106.300	2074875.800	-10.872	-7.05	-17.92	5.460
WH-SD022	WH-SD022-88_94	1122106.300	2074875.800	-10.872	-7.55	-18.42	9.371
WH-SD022	WH-SD022-94_100	1122106.300	2074875.800	-10.872	-8.05	-18.92	5.852
WH-SD022	WH-SD022-100_106	1122106.300	2074875.800	-10.872	-8.55	-19.42	5.571
WH-SD022	WH-SD022-106_112	1122106.300	2074875.800	-10.872	-9.05	-19.92	19.910
WH-SD022	WH-SD022-112_118	1122106.300	2074875.800	-10.872	-9.55	-20.42	16.905
WH-SD022	WH-SD022-118_124	1122106.300	2074875.800	-10.872	-10.05	-20.92	2.839
WH-SD022	WH-SD022-124_130	1122106.300	2074875.800	-10.872	-10.55	-21.42	2.539
WH-SD026	WH-SD026-00_04	1121943.500	2074654.300	-7.841	-0.15	-7.99	0.868
WH-SD026	WH-SD026-04_16	1121943.500	2074654.300	-7.841	-0.80	-8.64	1.271
WH-SD026	WH-SD026-16_28	1121943.500	2074654.300	-7.841	-1.80	-9.64	0.127 (ND)
WH-SD026	WH-SD026-28_40	1121943.500	2074654.300	-7.841	-2.80	-10.64	0.127 (ND)
WH-SD026	WH-SD026-40_56	1121943.500	2074654.300	-7.841	-3.95	-11.79	0.124 (ND)
WH-SD027	WH-SD027-00_04	1122207.900	2074644.800	-13.555	-0.15	-13.71	5.471
WH-SD027	WH-SD027-04_10	1122207.900	2074644.800	-13.555	-0.55	-14.11	10.205
WH-SD027	WH-SD027-10_16	1122207.900	2074644.800	-13.555	-1.05	-14.61	10.820
WH-SD027	WH-SD027-16_20	1122207.900	2074644.800	-13.555	-1.55	-15.11	8.025
WH-SD027	WH-SD027-22_28	1122207.900	2074644.800	-13.555	-2.05	-15.61	6.140
WH-SD027	WH-SD027-28_34	1122207.900	2074644.800	-13.555	-2.55	-16.11	36.640
WH-SD027	WH-SD027-34_40	1122207.900	2074644.800	-13.555	-3.05	-16.61	31.705

TABLE B-1

Summary of Total PCB Results Used in Feasibily Study

Waukegan Harbor RI

Location	Sample ID	X Coordinate [1]	Y Coordinate [1]	Top of Sediment Elevation (lwd IGLD85)	Sample Mid-point Depth (ft)	Sample Mid-point Elevation [2] (IGLD85)	Total PCB (ppm) [3]
WH-SD027	WH-SD027-40_46	1122207.900	2074644.800	-13.555	-3.55	-17.11	23.610
WH-SD027	WH-SD027-46_52	1122207.900	2074644.800	-13.555	-4.05	-17.61	25.595
WH-SD027	WH-SD027-52_58	1122207.900	2074644.800	-13.555	-4.60	-18.16	15.550
WH-SD027	WH-SD027-58_64	1122207.900	2074644.800	-13.555	-5.15	-18.71	8.075
WH-SD027	WH-SD027-64_70	1122207.900	2074644.800	-13.555	-5.75	-19.31	4.674
WH-SD027	WH-SD027-70_76	1122207.900	2074644.800	-13.555	-6.35	-19.91	5.463
WH-SD027	WH-SD027-76_82	1122207.900	2074644.800	-13.555	-6.85	-20.41	4.875
WH-SD027	WH-SD027-82_88	1122207.900	2074644.800	-13.555	-7.50	-21.06	6.158
WH-SD030	WH-SD030-00_04	1121950.300	2074409.800	-6.738	-0.15	-6.89	0.862
WH-SD030	WH-SD030-04_10	1121950.300	2074409.800	-6.738	-0.55	-7.29	1.546
WH-SD030	WH-SD030-10_14	1121950.300	2074409.800	-6.738	-0.95	-7.69	4.207
WH-SD030	WH-SD030-14_26	1121950.300	2074409.800	-6.738	-1.60	-8.34	1.191
WH-SD030	WH-SD030-26_38	1121950.300	2074409.800	-6.738	-2.80	-9.54	0.526
WH-SD030	WH-SD030-38_50	1121950.300	2074409.800	-6.738	-4.00	-10.74	0.234
WH-SD030	WH-SD030-50_59	1121950.300	2074409.800	-6.738	-5.30	-12.04	0.384
WH-SD031	WH-SD031-00_04	1122073.600	2074415.400	-7.278	-0.15	-7.43	1.070
WH-SD031	WH-SD031-04_12	1122073.600	2074415.400	-7.278	-0.65	-7.93	0.947
WH-SD031	WH-SD031-12_19	1122073.600	2074415.400	-7.278	-1.30	-8.58	2.162
WH-SD031	WH-SD031-19_31	1122073.600	2074415.400	-7.278	-2.15	-9.43	0.392
WH-SD031	WH-SD031-31_43	1122073.600	2074415.400	-7.278	-3.20	-10.48	0.272
WH-SD031	WH-SD031-43_55	1122073.600	2074415.400	-7.278	-4.35	-11.63	0.145
WH-SD031	WH-SD031-55_67	1122073.600	2074415.400	-7.278	-5.60	-12.88	0.179
WH-SD031	WH-SD031-67_76	1122073.600	2074415.400	-7.278	-6.40	-13.68	0.118 (ND)
WH-SD032	WH-SD032-00_04	1122010.000	2074223.500	-5.201	-0.15	-5.35	0.661
WH-SD032	WH-SD032-04_16	1122010.000	2074223.500	-5.201	-0.80	-6.00	0.803
WH-SD032	WH-SD032-16_28	1122010.000	2074223.500	-5.201	-1.80	-7.00	1.423
WH-SD032	WH-SD032-28_40	1122010.000	2074223.500	-5.201	-2.80	-8.00	1.924
WH-SD032	WH-SD032-40_52	1122010.000	2074223.500	-5.201	-3.80	-9.00	0.143
WH-SD032	WH-SD032-52_64	1122010.000	2074223.500	-5.201	-4.80	-10.00	0.165
WH-SD032	WH-SD032-64_79	1122010.000	2074223.500	-5.201	-6.00	-11.20	0.165
WH-SD033	WH-SD033-00_04	1122387.900	2074464.100	-8.626	-0.15	-8.78	3.686

TABLE B-1

Summary of Total PCB Results Used in Feasibily Study

Waukegan Harbor RI

Location	Sample ID	X Coordinate [1]	Y Coordinate [1]	Top of Sediment Elevation (lwd IGLD85)	Sample Mid-point Depth (ft)	Sample Mid-point Elevation [2] (IGLD85)	Total PCB (ppm) [3]
WH-SD033	WH-SD033-04_10	1122387.900	2074464.100	-8.626	-0.55	-9.18	3.061
WH-SD033	WH-SD033-10_16	1122387.900	2074464.100	-8.626	-1.05	-9.68	8.585
WH-SD033	WH-SD033-16_22	1122387.900	2074464.100	-8.626	-1.55	-10.18	7.345
WH-SD033	WH-SD033-22_30	1122387.900	2074464.100	-8.626	-2.05	-10.68	17.705
WH-SD033	WH-SD033-30_42	1122387.900	2074464.100	-8.626	-2.80	-11.43	0.931
WH-SD033	WH-SD033-42_54	1122387.900	2074464.100	-8.626	-3.80	-12.43	0.159 (ND)
WH-SD033	WH-SD033-54_72	1122387.900	2074464.100	-8.626	-5.05	-13.68	0.161 (ND)
WH-SD033	WH-SD033-72_84	1122387.900	2074464.100	-8.626	-6.30	-14.93	1.311
WH-SD033	WH-SD033-84_96	1122387.900	2074464.100	-8.626	-7.30	-15.93	0.148 (ND)
WH-SD033	WH-SD033-96_108	1122387.900	2074464.100	-8.626	-8.30	-16.93	0.136 (ND)
WH-SD033	WH-SD033-108_120	1122387.900	2074464.100	-8.626	-9.30	-17.93	0.124 (ND)
WH-SD033	WH-SD033-120_135	1122387.900	2074464.100	-8.626	-10.55	-19.18	0.133 (ND)
WH-SD057	WH-SD057-00_04	1122073.900	2074370.200	-7.298	-0.15	-7.45	0.540
WH-SD057	WH-SD057-04_08	1122073.900	2074370.200	-7.298	-0.45	-7.75	0.667
WH-SD057	WH-SD057-08_20	1122073.900	2074370.200	-7.298	-1.15	-8.45	0.421
WH-SD057	WH-SD057-20_32	1122073.900	2074370.200	-7.298	-2.45	-9.75	0.165
WH-SD057	WH-SD057-32_44	1122073.900	2074370.200	-7.298	-4.10	-11.40	0.125
WH-SD057	WH-SD057-44_53	1122073.900	2074370.200	-7.298	-5.45	-12.75	0.117
WH-SD075	WH-SD075-0.0/0.5	1122064.931	2074644.146	-7.83	-0.25	-8.08	0.392
WH-SD075	WH-SD075-0.5/1.0	1122064.931	2074644.146	-7.83	-0.75	-8.58	0.436
WH-SD075	WH-SD075-1.0/1.5	1122064.931	2074644.146	-7.83	-1.25	-9.08	0.282
WH-SD075	WH-SD075-1.5/2.0	1122064.931	2074644.146	-7.83	-1.75	-9.58	0.19
WH-SD075	WH-SD075-2.0/4.0	1122064.931	2074644.146	-7.83	-3.00	-10.83	0.141
WH-SD075	WH-SD075-4.0/5.0	1122064.931	2074644.146	-7.83	-4.50	-12.33	0.11 (ND)
WH-SD075	WH-SD075-5.0/6.0	1122064.931	2074644.146	-7.83	-5.50	-13.33	0.1075 (ND)
WH-SD075	WH-SD075-6.0/7.0	1122064.931	2074644.146	-7.83	-6.50	-14.33	0.1025 (ND)
WH-SD075	WH-SD075-7.0/8.0	1122064.931	2074644.146	-7.83	-7.50	-15.33	0.11 (ND)
WH-SD075	WH-SD075-8.0/9.0	1122064.931	2074644.146	-7.83	-8.50	-16.33	0.115 (ND)
WH-SD075	WH-SD075-9.0/10.0	1122064.931	2074644.146	-7.83	-9.50	-17.33	0.129
WH-SD076	WH-SD076-0.0/0.4	1122071.224	2074535.383	-9.05	-0.20	-9.25	0.302
WH-SD076	WH-SD076-0.4/1.4	1122071.224	2074535.383	-9.05	-0.90	-9.95	0.372

TABLE B-1

Summary of Total PCB Results Used in Feasibily Study

Waukegan Harbor RI

Location	Sample ID	X Coordinate [1]	Y Coordinate [1]	Top of Sediment Elevation (lwd IGLD85)	Sample Mid-point Depth (ft)	Sample Mid-point Elevation [2] (IGLD85)	Total PCB (ppm) [3]
WH-SD076	WH-SD076-1.4/2.4	1122071.224	2074535.383	-9.05	-1.90	-10.95	0.17
WH-SD076	WH-SD076-2.4/3.4	1122071.224	2074535.383	-9.05	-2.90	-11.95	0.1025 (ND)
WH-SD076	WH-SD076-3.4/4.4	1122071.224	2074535.383	-9.05	-3.90	-12.95	0.148
WH-SD076	WH-SD076-4.4/5.4	1122071.224	2074535.383	-9.05	-4.90	-13.95	0.104
WH-SD076	WH-SD076-5.4/6.4	1122071.224	2074535.383	-9.05	-5.90	-14.95	0.1 (ND)
WH-SD076	WH-SD076-6.4/7.4	1122071.224	2074535.383	-9.05	-6.90	-15.95	0.1025 (ND)
WH-SD076	WH-SD076-7.4/8.4	1122071.224	2074535.383	-9.05	-7.90	-16.95	0.1025 (ND)
WH-SD076	WH-SD076-8.4/9.4	1122071.224	2074535.383	-9.05	-8.90	-17.95	0.1025 (ND)
WH-SD076	WH-SD076-9.4/10.5	1122071.224	2074535.383	-9.05	-9.95	-19.00	0.1025 (ND)
WHSP-01	WH-2002-16.1	1122218.000	2074305.000	-6.428	-0.25	-6.68	0.877
WHSP-01	WH-2002-16.2	1122218.000	2074305.000	-6.428	-1.17	-7.60	0.145
WHSP-01	WH-2002-16.3	1122218.000	2074305.000	-6.428	-2.17	-8.60	0.947 (ND)
Entrance Channel							
WH-SD035	WH-SD035-00_12	1123088.300	2074521.300	-15.214	-0.50	-15.71	0.829
WH-SD035	WH-SD035-12_24	1123088.300	2074521.300	-15.214	-1.50	-16.71	0.727
WH-SD035	WH-SD035-24_30	1123088.300	2074521.300	-15.214	-2.25	-17.46	2.433
WH-SD035	WH-SD035-30_36	1123088.300	2074521.300	-15.214	-2.75	-17.96	1.725
WH-SD035	WH-SD035-36_42	1123088.300	2074521.300	-15.214	-3.25	-18.46	2.136
WH-SD035	WH-SD035-42_48	1123088.300	2074521.300	-15.214	-3.75	-18.96	1.927
WH-SD035	WH-SD035-48_54	1123088.300	2074521.300	-15.214	-4.25	-19.46	2.927
WH-SD035	WH-SD035-54_60	1123088.300	2074521.300	-15.214	-4.75	-19.96	0.835
WH-SD035	WH-SD035-60_66	1123088.300	2074521.300	-15.214	-5.25	-20.46	0.455
WH-SD035	WH-SD035-66_72	1123088.300	2074521.300	-15.214	-5.75	-20.96	0.373
WH-SD035	WH-SD035-72_78	1123088.300	2074521.300	-15.214	-6.25	-21.46	1.528
WH-SD035	WH-SD035-78_84	1123088.300	2074521.300	-15.214	-6.75	-21.96	2.533
WH-SD035	WH-SD035-84_90	1123088.300	2074521.300	-15.214	-7.25	-22.46	1.925
WH-SD035	WH-SD035-90_96	1123088.300	2074521.300	-15.214	-7.75	-22.96	0.878
WH-SD035	WH-SD035-96_102	1123088.300	2074521.300	-15.214	-8.25	-23.46	2.846
WH-SD035	WH-SD035-102_108	1123088.300	2074521.300	-15.214	-8.75	-23.96	3.425
WH-SD035	WH-SD035-108_120	1123088.300	2074521.300	-15.214	-9.50	-24.71	0.155
WH-SD035	WH-SD035-120_132	1123088.300	2074521.300	-15.214	-10.50	-25.71	0.119

TABLE B-1

Summary of Total PCB Results Used in Feasibily Study

Waukegan Harbor RI

Location	Sample ID	X Coordinate [1]	Y Coordinate [1]	Top of Sediment Elevation (lwd IGLD85)	Sample Mid-point Depth (ft)	Sample Mid-point Elevation [2] (IGLD85)	Total PCB (ppm) [3]
WH-SD036	WH-SD036-00_12	1123296.000	2074638.300	-19.395	-0.50	-19.90	0.436
WH-SD036	WH-SD036-12_24	1123296.000	2074638.300	-19.395	-1.50	-20.90	0.211
WH-SD036	WH-SD036-24_36	1123296.000	2074638.300	-19.395	-2.50	-21.90	0.115 (ND)
WH-SD037	WH-SD037-00_24	1123525.900	2074603.200	-21.106	-1.00	-22.11	1.621
WH-SD037	WH-SD037-24_31	1123525.900	2074603.200	-21.106	-2.30	-23.41	1.170
WH-SD037	WH-SD037-31_43	1123525.900	2074603.200	-21.106	-3.10	-24.21	0.109
WH-SD038	WH-SD038-00_06	1123730.500	2074513.400	-15.412	-0.25	-15.66	0.456
WH-SD038	WH-SD038-06_12	1123730.500	2074513.400	-15.412	-0.75	-16.16	0.587
WH-SD038	WH-SD038-12_18	1123730.500	2074513.400	-15.412	-1.25	-16.66	0.414
WH-SD038	WH-SD038-18_24	1123730.500	2074513.400	-15.412	-1.75	-17.16	4.075
WH-SD038	WH-SD038-24_30	1123730.500	2074513.400	-15.412	-2.25	-17.66	8.425
WH-SD038	WH-SD038-30_36	1123730.500	2074513.400	-15.412	-2.75	-18.16	2.413
WH-SD038	WH-SD038-36_42	1123730.500	2074513.400	-15.412	-3.25	-18.66	0.746
WH-SD038	WH-SD038-42_48	1123730.500	2074513.400	-15.412	-3.75	-19.16	0.503
WH-SD038	WH-SD038-48_54	1123730.500	2074513.400	-15.412	-4.25	-19.66	0.479
WH-SD038	WH-SD038-54_60	1123730.500	2074513.400	-15.412	-4.75	-20.16	3.925
WH-SD038	WH-SD038-60_66	1123730.500	2074513.400	-15.412	-5.60	-21.01	7.980
WH-SD038	WH-SD038-66_72	1123730.500	2074513.400	-15.412	-6.45	-21.86	5.475
WH-SD038	WH-SD038-72_78	1123730.500	2074513.400	-15.412	-6.95	-22.36	2.335
WH-SD038	WH-SD038-78_84	1123730.500	2074513.400	-15.412	-7.45	-22.86	4.875
WH-SD038	WH-SD038-84_90	1123730.500	2074513.400	-15.412	-7.95	-23.36	5.780
WH-SD038	WH-SD038-90_96	1123730.500	2074513.400	-15.412	-8.45	-23.86	1.721
WH-SD038	WH-SD038-96_102	1123730.500	2074513.400	-15.412	-8.95	-24.36	0.628
WH-SD038	WH-SD038-102_114	1123730.500	2074513.400	-15.412	-9.70	-25.11	0.266
WH-SD038	WH-SD038-114_126	1123730.500	2074513.400	-15.412	-10.70	-26.11	0.121 (ND)
WH-SD038	WH-SD038-126_138	1123730.500	2074513.400	-15.412	-11.95	-27.36	0.109 (ND)
WH-SD039	WH-SD039-00_12	1123958.100	2074629.800	-17.484	-0.50	-17.98	0.271
WH-SD039	WH-SD039-12_24	1123958.100	2074629.800	-17.484	-1.50	-18.98	0.354
WH-SD039	WH-SD039-24_30	1123958.100	2074629.800	-17.484	-2.25	-19.73	0.371
WH-SD039	WH-SD039-30_36	1123958.100	2074629.800	-17.484	-2.75	-20.23	0.623
WH-SD039	WH-SD039-36_46	1123958.100	2074629.800	-17.484	-3.45	-20.93	0.128

TABLE B-1

Summary of Total PCB Results Used in Feasibily Study

Waukegan Harbor RI

Location	Sample ID	X Coordinate [1]	Y Coordinate [1]	Top of Sediment Elevation (lwd IGLD85)	Sample Mid-point Depth (ft)	Sample Mid-point Elevation [2] (IGLD85)	Total PCB (ppm) [3]
WH-SD039	WH-SD039-46_58	1123958.100	2074629.800	-17.484	-4.40	-21.88	0.115 (ND)
WH-SD040	WH-SD040-00_06	1124181.300	2074599.300	-19.847	-0.25	-20.10	0.316
WH-SD040	WH-SD040-06_12	1124181.300	2074599.300	-19.847	-0.75	-20.60	0.478
WH-SD040	WH-SD040-12_18	1124181.300	2074599.300	-19.847	-1.25	-21.10	2.636
WH-SD040	WH-SD040-18_30	1124181.300	2074599.300	-19.847	-2.00	-21.85	0.758
WH-SD040	WH-SD040-30_42	1124181.300	2074599.300	-19.847	-3.00	-22.85	0.127 (ND)
WH-SD040	WH-SD040-42_48	1124181.300	2074599.300	-19.847	-4.75	-24.60	0.529
WH-SD040	WH-SD040-48_60	1124181.300	2074599.300	-19.847	-6.50	-26.35	0.127 (ND)
WH-SD041	WH-SD041-00_24	1124406.900	2074505.800	-20.289	-1.00	-21.29	0.238
WH-SD041	WH-SD041-24_48	1124406.900	2074505.800	-20.289	-3.00	-23.29	0.248
WH-SD041	WH-SD041-48_54	1124406.900	2074505.800	-20.289	-4.30	-24.59	0.263
WH-SD041	WH-SD041-54_76	1124406.900	2074505.800	-20.289	-5.60	-25.89	0.299
WH-SD041	WH-SD041-76_88	1124406.900	2074505.800	-20.289	-7.55	-27.84	0.112 (ND)
WH-SD058	WH-SD058-00_12	1123755.600	2074529.400	-16.793	-0.50	-17.29	0.481
WH-SD058	WH-SD058-12_18	1123755.600	2074529.400	-16.793	-1.25	-18.04	1.211
WH-SD058	WH-SD058-18_24	1123755.600	2074529.400	-16.793	-1.75	-18.54	2.611
WH-SD058	WH-SD058-24_30	1123755.600	2074529.400	-16.793	-2.75	-19.54	3.627
WH-SD058	WH-SD058-30_36	1123755.600	2074529.400	-16.793	-3.75	-20.54	1.613
WH-SD058	WH-SD058-36_42	1123755.600	2074529.400	-16.793	-4.25	-21.04	0.214
WH-SD058	WH-SD058-42_48	1123755.600	2074529.400	-16.793	-4.75	-21.54	0.171
WH-SD058	WH-SD058-48_54	1123755.600	2074529.400	-16.793	-5.25	-22.04	0.209
WH-SD058	WH-SD058-54_60	1123755.600	2074529.400	-16.793	-5.75	-22.54	0.161 (ND)
WH-SD058	WH-SD058-60_72	1123755.600	2074529.400	-16.793	-6.50	-23.29	0.148 (ND)
WH-SD058	WH-SD058-72_84	1123755.600	2074529.400	-16.793	-7.25	-24.04	0.124 (ND)
WH-SD058	WH-SD058-84_96	1123755.600	2074529.400	-16.793	-8.00	-24.79	0.121 (ND)
WH-SD077	WH-SD077-0.0/0.5	1122211.713	2074549.382	-12.89	-0.25	-13.14	0.314
WH-SD077	WH-SD077-0.5/1.0	1122211.713	2074549.382	-12.89	-0.75	-13.64	0.692
WH-SD077	WH-SD077-1.0/1.5	1122211.713	2074549.382	-12.89	-1.25	-14.14	1.025
WH-SD077	WH-SD077-1.5/2.0	1122211.713	2074549.382	-12.89	-1.75	-14.64	0.888
WH-SD077	WH-SD077-2.0/2.5	1122211.713	2074549.382	-12.89	-2.25	-15.14	0.422
WH-SD077	WH-SD077-2.5/3.0	1122211.713	2074549.382	-12.89	-2.75	-15.64	2.865

TABLE B-1

Summary of Total PCB Results Used in Feasibily Study

Waukegan Harbor RI

Location	Sample ID	X Coordinate [1]	Y Coordinate [1]	Top of Sediment Elevation (lwd IGLD85)	Sample Mid-point Depth (ft)	Sample Mid-point Elevation [2] (IGLD85)	Total PCB (ppm) [3]
WH-SD077	WH-SD077-3.0/3.5	1122211.713	2074549.382	-12.89	-3.25	-16.14	2.197
WH-SD077	WH-SD077-3.5/4.0	1122211.713	2074549.382	-12.89	-3.75	-16.64	1.415
WH-SD077	WH-SD077-4.0/4.5	1122211.713	2074549.382	-12.89	-4.25	-17.14	1.6105
WH-SD077	WH-SD077-4.5/5.0	1122211.713	2074549.382	-12.89	-4.75	-17.64	1.093
WH-SD077	WH-SD077-5.0/5.5	1122211.713	2074549.382	-12.89	-5.25	-18.14	2.2305
WH-SD077	WH-SD077-5.5/6.0	1122211.713	2074549.382	-12.89	-5.75	-18.64	1.09
WH-SD077	WH-SD077-6.0/6.5	1122211.713	2074549.382	-12.89	-6.25	-19.14	2.8805
WH-SD077	WH-SD077-6.5/7.0	1122211.713	2074549.382	-12.89	-6.75	-19.64	2.589
WH-SD077	WH-SD077-7.0/7.5	1122211.713	2074549.382	-12.89	-7.25	-20.14	2.9215
WH-SD077	WH-SD077-7.5/8.0	1122211.713	2074549.382	-12.89	-7.75	-20.64	1.644
WH-SD077	WH-SD077-8.0/8.5	1122211.713	2074549.382	-12.89	-8.25	-21.14	1.58
WH-SD077	WH-SD077-8.5/9.0	1122211.713	2074549.382	-12.89	-8.75	-21.64	2.8325
WH-SD077	WH-SD077-9.0/9.5	1122211.713	2074549.382	-12.89	-9.25	-22.14	2.1925
WH-SD077	WH-SD077-9.5/10.0	1122211.713	2074549.382	-12.89	-9.75	-22.64	1.1825
WH-SD077	WH-SD077-10.0/10.7	1122211.713	2074549.382	-12.89	-10.35	-23.24	1.0755
WH-SD078	WH-SD078-0.0/1.0	1123040.476	2074681.439	-16.85	-0.50	-17.35	0.2855
WH-SD078	WH-SD078-1.0/2.0	1123040.476	2074681.439	-16.85	-1.50	-18.35	0.739
WH-SD078	WH-SD078-2.0/3.0	1123040.476	2074681.439	-16.85	-2.50	-19.35	0.3785
WH-SD078	WH-SD078-3.0/4.0	1123040.476	2074681.439	-16.85	-3.50	-20.35	0.362
WH-SD078	WH-SD078-4.0/5.0	1123040.476	2074681.439	-16.85	-4.50	-21.35	0.206
WH-SD078	WH-SD078-5.0/6.0	1123040.476	2074681.439	-16.85	-5.50	-22.35	0.273
WH-SD078	WH-SD078-6.0/7.3	1123040.476	2074681.439	-16.85	-6.65	-23.50	0.5585
WH-SD079	WH-SD079-0.0/1.0	1123604.283	2074681.207	-10.79	-0.50	-11.29	0.127
WH-SD079	WH-SD079-1.0/2.0	1123604.283	2074681.207	-10.79	-1.50	-12.29	0.1025 (ND)
WH-SD079	WH-SD079-2.0/3.0	1123604.283	2074681.207	-10.79	-2.50	-13.29	0.1025
WH-SD079	WH-SD079-3.0/4.0	1123604.283	2074681.207	-10.79	-3.50	-14.29	0.1
WH-SD079	WH-SD079-4.0/5.0	1123604.283	2074681.207	-10.79	-4.50	-15.29	0.114
WH-SD079	WH-SD079-5.0/6.0	1123604.283	2074681.207	-10.79	-5.50	-16.29	0.1495 (ND)
WH-SD079	WH-SD079-6.0/7.0	1123604.283	2074681.207	-10.79	-6.50	-17.29	0.1 (ND)
WH-SD079	WH-SD079-7.0/8.0	1123604.283	2074681.207	-10.79	-7.50	-18.29	0.1 (ND)
WH-SD079	WH-SD079-8.0/9.0	1123604.283	2074681.207	-10.79	-8.50	-19.29	0.1

TABLE B-1

Summary of Total PCB Results Used in Feasibily Study

Waukegan Harbor RI

Location	Sample ID	X Coordinate [1]	Y Coordinate [1]	Top of Sediment Elevation (lwd IGLD85)	Sample Mid-point Depth (ft)	Sample Mid-point Elevation [2] (IGLD85)	Total PCB (ppm) [3]
WH-SD079	WH-SD079-9.0/10.0	1123604.283	2074681.207	-10.79	-9.50	-20.29	0.1
WH-SD079	WH-SD079-10.0/11.0	1123604.283	2074681.207	-10.79	-10.50	-21.29	0.0904 (ND)
WH-SD079	WH-SD079-11.0/12.0	1123604.283	2074681.207	-10.79	-11.50	-22.29	0.1625 (ND)
WH-SD079	WH-SD079-12.0/13.0	1123604.283	2074681.207	-10.79	-12.50	-23.29	0.1012 (ND)
WH-SD079	WH-SD079-13.0/13.8	1123604.283	2074681.207	-10.79	-13.40	-24.19	0.1 (ND)
WH-SD080	WH-SD080-0.0/1.0	1123602.070	2074511.363	-13.96	-0.50	-14.46	0.1865
WH-SD080	WH-SD080-1.0/2.0	1123602.070	2074511.363	-13.96	-1.50	-15.46	0.4165
WH-SD080	WH-SD080-2.0/3.0	1123602.070	2074511.363	-13.96	-2.50	-16.46	0.3745
WH-SD080	WH-SD080-3.0/4.0	1123602.070	2074511.363	-13.96	-3.50	-17.46	0.527
WH-SD080	WH-SD080-4.0/5.0	1123602.070	2074511.363	-13.96	-4.50	-18.46	0.5135
WH-SD080	WH-SD080-5.0/6.0	1123602.070	2074511.363	-13.96	-5.50	-19.46	0.4545
WH-SD080	WH-SD080-6.0/7.0	1123602.070	2074511.363	-13.96	-6.50	-20.46	0.536
WH-SD080	WH-SD080-7.0/8.0	1123602.070	2074511.363	-13.96	-7.50	-21.46	0.5775
WH-SD080	WH-SD080-8.0/9.0	1123602.070	2074511.363	-13.96	-8.50	-22.46	0.5875
WH-SD080	WH-SD080-9.0/10.0	1123602.070	2074511.363	-13.96	-9.50	-23.46	0.105
WH-SD080	WH-SD080-10.0/11.2	1123602.070	2074511.363	-13.96	-10.60	-24.56	0.217 (ND)
WH-SD081	WH-SD081-0.0/1.0	1124169.282	2074677.533	-17.24	-0.50	-17.74	0.112
WH-SD081	WH-SD081-1.0/2.0	1124169.282	2074677.533	-17.24	-1.50	-18.74	0.145
WH-SD081	WH-SD081-2.0/3.0	1124169.282	2074677.533	-17.24	-2.50	-19.74	0.1585
WH-SD081	WH-SD081-3.0/4.0	1124169.282	2074677.533	-17.24	-3.50	-20.74	0.142
WH-SD081	WH-SD081-4.0/5.0	1124169.282	2074677.533	-17.24	-4.50	-21.74	0.105 (ND)
WH-SD081	WH-SD081-5.0/6.0	1124169.282	2074677.533	-17.24	-5.50	-22.74	0.0787
WH-SD082	WH-SD082-0.0/0.5	1124183.154	2074515.259	-19.08	-0.25	-19.33	0.146
WH-SD082	WH-SD082-0.5/1.0	1124183.154	2074515.259	-19.08	-0.75	-19.83	0.194
WH-SD082	WH-SD082-1.0/1.5	1124183.154	2074515.259	-19.08	-1.25	-20.33	0.1855
WH-SD082	WH-SD082-1.5/2.0	1124183.154	2074515.259	-19.08	-1.75	-20.83	0.21
WH-SD082	WH-SD082-2.0/2.5	1124183.154	2074515.259	-19.08	-2.25	-21.33	0.126
WH-SD082	WH-SD082-2.5/3.1	1124183.154	2074515.259	-19.08	-2.80	-21.88	0.126
WH-SD082	WH-SD082-3.1/4.1	1124183.154	2074515.259	-19.08	-3.60	-22.68	0.1 (ND)
WH-SD082	WH-SD082-4.1/4.6	1124183.154	2074515.259	-19.08	-4.35	-23.43	0.1 (ND)

TABLE B-1

Summary of Total PCB Results Used in Feasibily Study

Waukegan Harbor RI

Location	Sample ID	X Coordinate [1]	Y Coordinate [1]	Top of Sediment Elevation (lwd IGLD85)	Sample Mid-point Depth (ft)	Sample Mid-point Elevation [2] (IGLD85)	Total PCB (ppm) [3]
Outer Harbor							
WH-SD042	WH-SD042-00_12	1124621.800	2074654.000	-17.371	-0.50	-17.87	0.208
WH-SD042	WH-SD042-12_24	1124621.800	2074654.000	-17.371	-1.50	-18.87	0.203
WH-SD042	WH-SD042-24_36	1124621.800	2074654.000	-17.371	-2.50	-19.87	0.188
WH-SD042	WH-SD042-36_42	1124621.800	2074654.000	-17.371	-3.25	-20.62	0.196
WH-SD042	WH-SD042-42_54	1124621.800	2074654.000	-17.371	-4.00	-21.37	0.195
WH-SD042	WH-SD042-54_66	1124621.800	2074654.000	-17.371	-5.00	-22.37	0.228
WH-SD042	WH-SD042-66-78	1124621.800	2074654.000	-17.371	-6.00	-23.37	0.246
WH-SD042	WH-SD042-78_90	1124621.800	2074654.000	-17.371	-7.00	-24.37	0.476
WH-SD042	WH-SD042-90_102	1124621.800	2074654.000	-17.371	-8.00	-25.37	0.456
WH-SD042	WH-SD042-102_114	1124621.800	2074654.000	-17.371	-9.00	-26.37	1.210
WH-SD042	WH-SD042-114-126	1124621.800	2074654.000	-17.371	-10.00	-27.37	1.108
WH-SD042	WH-SD042-126_140	1124621.800	2074654.000	-17.371	-11.25	-28.62	0.118 (ND)
WH-SD042	WH-SD042-140_152	1124621.800	2074654.000	-17.371	-12.50	-29.87	0.112 (ND)
WH-SD043	WH-SD043-00_12	1124709.200	2074858.800	-15.845	-0.50	-16.35	0.163
WH-SD043	WH-SD043-12_24	1124709.200	2074858.800	-15.845	-1.75	-17.60	0.221
WH-SD043	WH-SD043-24_36	1124709.200	2074858.800	-15.845	-3.00	-18.85	0.944
WH-SD043	WH-SD043-36_48	1124709.200	2074858.800	-15.845	-4.00	-19.85	0.861
WH-SD043	WH-SD043-48_60	1124709.200	2074858.800	-15.845	-5.10	-20.95	0.314
WH-SD043	WH-SD043-60_72	1124709.200	2074858.800	-15.845	-6.20	-22.05	0.251
WH-SD043	WH-SD043-72_84	1124709.200	2074858.800	-15.845	-7.20	-23.05	0.124
WH-SD043	WH-SD043-84_96	1124709.200	2074858.800	-15.845	-8.20	-24.05	0.366
WH-SD043	WH-SD043-96_108	1124709.200	2074858.800	-15.845	-9.20	-25.05	0.121 (ND)
WH-SD043	WH-SD043-108_120	1124709.200	2074858.800	-15.845	-10.20	-26.05	0.202
WH-SD043	WH-SD043-120_132	1124709.200	2074858.800	-15.845	-11.40	-27.25	0.112 (ND)
WH-SD044	WH-SD044-00_12	1124840.600	2074660.300	-17.546	-0.50	-18.05	0.179
WH-SD044	WH-SD044-12_24	1124840.600	2074660.300	-17.546	-2.50	-20.05	0.188
WH-SD044	WH-SD044-24_30	1124840.600	2074660.300	-17.546	-4.25	-21.80	0.177
WH-SD044	WH-SD044-30_36	1124840.600	2074660.300	-17.546	-4.75	-22.30	0.248
WH-SD044	WH-SD044-36_42	1124840.600	2074660.300	-17.546	-5.25	-22.80	0.335
WH-SD044	WH-SD044-42_48	1124840.600	2074660.300	-17.546	-5.75	-23.30	0.254

TABLE B-1

Summary of Total PCB Results Used in Feasibily Study

Waukegan Harbor RI

Location	Sample ID	X Coordinate [1]	Y Coordinate [1]	Top of Sediment Elevation (lwd IGLD85)	Sample Mid-point Depth (ft)	Sample Mid-point Elevation [2] (IGLD85)	Total PCB (ppm) [3]
WH-SD044	WH-SD044-48_54	1124840.600	2074660.300	-17.546	-6.25	-23.80	0.287
WH-SD044	WH-SD044-54_60	1124840.600	2074660.300	-17.546	-6.75	-24.30	0.304
WH-SD044	WH-SD044-60_66	1124840.600	2074660.300	-17.546	-7.25	-24.80	0.321
WH-SD044	WH-SD044-66_72	1124840.600	2074660.300	-17.546	-7.75	-25.30	0.386
WH-SD044	WH-SD044-72_78	1124840.600	2074660.300	-17.546	-8.25	-25.80	0.266
WH-SD044	WH-SD044-78_84	1124840.600	2074660.300	-17.546	-8.75	-26.30	0.568
WH-SD044	WH-SD044-84_96	1124840.600	2074660.300	-17.546	-9.25	-26.80	0.386
WH-SD044	WH-SD044-96_104	1124840.600	2074660.300	-17.546	-9.75	-27.30	0.192
WH-SD044	WH-SD044-104_110	1124840.600	2074660.300	-17.546	-10.25	-27.80	0.458
WH-SD044	WH-SD044-110_116	1124840.600	2074660.300	-17.546	-10.80	-28.35	0.184
WH-SD044	WH-SD044-116_128	1124840.600	2074660.300	-17.546	-11.55	-29.10	0.109 (ND)
WH-SD045	WH-SD045-00_12	1124915.400	2074425.300	-18.785	-0.50	-19.29	0.176
WH-SD045	WH-SD045-12_24	1124915.400	2074425.300	-18.785	-1.50	-20.29	0.221
WH-SD045	WH-SD045-24_40	1124915.400	2074425.300	-18.785	-2.65	-21.44	0.386
WH-SD045	WH-SD045-40_49	1124915.400	2074425.300	-18.785	-3.70	-22.49	0.205
WH-SD045	WH-SD045-49_61	1124915.400	2074425.300	-18.785	-4.60	-23.39	0.130 (ND)
WH-SD045	WH-SD045-61_73	1124915.400	2074425.300	-18.785	-5.60	-24.39	0.127 (ND)
WH-SD045	WH-SD045-73_89	1124915.400	2074425.300	-18.785	-6.75	-25.54	0.127 (ND)
WH-SD045	WH-SD045-89_101	1124915.400	2074425.300	-18.785	-7.95	-26.74	0.112 (ND)
WH-SD046	WH-SD046-00_12	1124962.700	2074871.500	-16.772	-0.50	-17.27	0.185
WH-SD046	WH-SD046-12_24	1124962.700	2074871.500	-16.772	-1.50	-18.27	0.186
WH-SD046	WH-SD046-24_30	1124962.700	2074871.500	-16.772	-2.25	-19.02	0.216 (ND)
WH-SD046	WH-SD046-30_38	1124962.700	2074871.500	-16.772	-3.25	-20.02	0.179 (ND)
WH-SD046	WH-SD046-48_72	1124962.700	2074871.500	-16.772	-5.00	-21.77	0.221
WH-SD046	WH-SD046-72_96	1124962.700	2074871.500	-16.772	-7.00	-23.77	0.251
WH-SD046	WH-SD046-96_120	1124962.700	2074871.500	-16.772	-9.00	-25.77	0.177
WH-SD046	WH-SD046-120_148	1124962.700	2074871.500	-16.772	-11.15	-27.92	0.127
WH-SD046	WH-SD046-148_164	1124962.700	2074871.500	-16.772	-12.80	-29.57	0.112
WH-SD047	WH-SD047-00_12	1125025.900	2074656.300	-17.751	-0.50	-18.25	0.203
WH-SD047	WH-SD047-12_24	1125025.900	2074656.300	-17.751	-1.50	-19.25	0.243
WH-SD047	WH-SD047-24_42	1125025.900	2074656.300	-17.751	-2.75	-20.50	0.170

TABLE B-1

Summary of Total PCB Results Used in Feasibily Study

Waukegan Harbor RI

Location	Sample ID	X Coordinate [1]	Y Coordinate [1]	Top of Sediment Elevation (lwd IGLD85)	Sample Mid-point Depth (ft)	Sample Mid-point Elevation [2] (IGLD85)	Total PCB (ppm) [3]
WH-SD047	WH-SD047-42_48	1125025.900	2074656.300	-17.751	-3.75	-21.50	0.259
WH-SD047	WH-SD047-48_54	1125025.900	2074656.300	-17.751	-4.25	-22.00	0.172
WH-SD047	WH-SD047-54_60	1125025.900	2074656.300	-17.751	-5.40	-23.15	0.247
WH-SD047	WH-SD047-60_66	1125025.900	2074656.300	-17.751	-6.55	-24.30	0.187
WH-SD047	WH-SD047-66_72	1125025.900	2074656.300	-17.751	-7.55	-25.30	0.216
WH-SD047	WH-SD047-72_84	1125025.900	2074656.300	-17.751	-8.80	-26.55	0.111 (ND)
WH-SD048	WH-SD048-00_12	1125168.500	2074878.400	-17.650	-0.50	-18.15	0.162
WH-SD048	WH-SD048-12_24	1125168.500	2074878.400	-17.650	-1.50	-19.15	0.195
WH-SD048	WH-SD048-24_38	1125168.500	2074878.400	-17.650	-2.60	-20.25	0.189
WH-SD048	WH-SD048-38_44	1125168.500	2074878.400	-17.650	-3.45	-21.10	0.171
WH-SD048	WH-SD048-44_50	1125168.500	2074878.400	-17.650	-3.95	-21.60	0.230
WH-SD048	WH-SD048-50_56	1125168.500	2074878.400	-17.650	-4.45	-22.10	0.215
WH-SD048	WH-SD048-56_62	1125168.500	2074878.400	-17.650	-4.95	-22.60	0.199
WH-SD048	WH-SD048-62_68	1125168.500	2074878.400	-17.650	-5.45	-23.10	0.185
WH-SD048	WH-SD048-68_80	1125168.500	2074878.400	-17.650	-6.20	-23.85	0.164
WH-SD048	WH-SD048-80_92	1125168.500	2074878.400	-17.650	-7.20	-24.85	0.127 (ND)
WH-SD048	WH-SD048-92_104	1125168.500	2074878.400	-17.650	-8.20	-25.85	0.127 (ND)
WH-SD048	WH-SD048-104_121	1125168.500	2074878.400	-17.650	-9.35	-27.00	0.127 (ND)
WH-SD048	WH-SD048-121_133	1125168.500	2074878.400	-17.650	-10.50	-28.15	0.109 (ND)
WH-SD049	WH-SD049-00_06	1125374.200	2074884.500	-19.762	-0.25	-20.01	0.159
WH-SD049	WH-SD049-06_12	1125374.200	2074884.500	-19.762	-0.75	-20.51	0.146
WH-SD049	WH-SD049-12_24	1125374.200	2074884.500	-19.762	-1.50	-21.26	0.141
WH-SD049	WH-SD049-24_36	1125374.200	2074884.500	-19.762	-2.50	-22.26	0.190
WH-SD049	WH-SD049-36_48	1125374.200	2074884.500	-19.762	-3.50	-23.26	0.192
WH-SD049	WH-SD049-48_60	1125374.200	2074884.500	-19.762	-4.50	-24.26	0.177
WH-SD049	WH-SD049-60_72	1125374.200	2074884.500	-19.762	-5.50	-25.26	0.124
WH-SD049	WH-SD049-72_84	1125374.200	2074884.500	-19.762	-6.50	-26.26	0.157
WH-SD049	WH-SD049-84_96	1125374.200	2074884.500	-19.762	-7.50	-27.26	0.158
WH-SD049	WH-SD049-96_108	1125374.200	2074884.500	-19.762	-8.50	-28.26	0.113 (ND)
WH-SD049	WH-SD049-108_126	1125374.200	2074884.500	-19.762	-9.80	-29.56	0.127 (ND)
WH-SD049	WH-SD049-126_138	1125374.200	2074884.500	-19.762	-11.10	-30.86	0.111 (ND)

TABLE B-1

Summary of Total PCB Results Used in Feasibily Study

Waukegan Harbor RI

Location	Sample ID	X Coordinate [1]	Y Coordinate [1]	Top of Sediment Elevation (lwd IGLD85)	Sample Mid-point Depth (ft)	Sample Mid-point Elevation [2] (IGLD85)	Total PCB (ppm) [3]
WH-SD050	WH-SD050-00_24	1125262.600	2074635.100	-18.588	-1.00	-19.59	0.155
WH-SD050	WH-SD050-24_48	1125262.600	2074635.100	-18.588	-3.00	-21.59	0.222
WH-SD050	WH-SD050-48_54	1125262.600	2074635.100	-18.588	-4.25	-22.84	0.209
WH-SD050	WH-SD050-54_60	1125262.600	2074635.100	-18.588	-4.75	-23.34	0.177
WH-SD050	WH-SD050-60_66	1125262.600	2074635.100	-18.588	-5.25	-23.84	0.258
WH-SD050	WH-SD050-66_72	1125262.600	2074635.100	-18.588	-5.75	-24.34	0.263
WH-SD050	WH-SD050-72_78	1125262.600	2074635.100	-18.588	-6.25	-24.84	0.251
WH-SD050	WH-SD050-78_84	1125262.600	2074635.100	-18.588	-6.50	-25.09	0.249
WH-SD050	WH-SD050-84_96	1125262.600	2074635.100	-18.588	-7.50	-26.09	0.142
WH-SD050	WH-SD050-120_144	1125262.600	2074635.100	-18.588	-10.50	-29.09	0.114 (ND)
WH-SD051	WH-SD051-00_12	1125144.800	2074430.700	-15.992	-0.50	-16.49	0.141
WH-SD051	WH-SD051-12_24	1125144.800	2074430.700	-15.992	-1.50	-17.49	0.145
WH-SD051	WH-SD051-24_36	1125144.800	2074430.700	-15.992	-2.50	-18.49	0.133
WH-SD051	WH-SD051-36_48	1125144.800	2074430.700	-15.992	-3.50	-19.49	0.161
WH-SD051	WH-SD051-48_60	1125144.800	2074430.700	-15.992	-4.50	-20.49	0.174
WH-SD051	WH-SD051-60_72	1125144.800	2074430.700	-15.992	-5.50	-21.49	0.173
WH-SD051	WH-SD051-72_84	1125144.800	2074430.700	-15.992	-6.50	-22.49	0.142
WH-SD051	WH-SD051-84_96	1125144.800	2074430.700	-15.992	-7.60	-23.59	0.115
WH-SD051	WH-SD051-96_114	1125144.800	2074430.700	-15.992	-9.45	-25.44	0.114 (ND)
WH-SD051	WH-SD051-114_126	1125144.800	2074430.700	-15.992	-11.50	-27.49	0.115 (ND)
WH-SD052	WH-SD052-00_12	1125359.800	2074420.400	-14.810	-0.50	-15.31	0.130
WH-SD052	WH-SD052-12_24	1125359.800	2074420.400	-14.810	-1.50	-16.31	0.137
WH-SD052	WH-SD052-24_36	1125359.800	2074420.400	-14.810	-2.50	-17.31	0.147
WH-SD052	WH-SD052-36_48	1125359.800	2074420.400	-14.810	-3.50	-18.31	0.129
WH-SD052	WH-SD052-48_60	1125359.800	2074420.400	-14.810	-4.50	-19.31	0.176
WH-SD052	WH-SD052-60_72	1125359.800	2074420.400	-14.810	-5.50	-20.31	0.136
WH-SD052	WH-SD052-72_84	1125359.800	2074420.400	-14.810	-6.50	-21.31	0.153
WH-SD052	WH-SD052-84_96	1125359.800	2074420.400	-14.810	-7.50	-22.31	0.180
WH-SD052	WH-SD052-96_108	1125359.800	2074420.400	-14.810	-8.50	-23.31	0.124
WH-SD052	WH-SD052-108_120	1125359.800	2074420.400	-14.810	-9.50	-24.31	0.122
WH-SD052	WH-SD052-120_132	1125359.800	2074420.400	-14.810	-10.50	-25.31	0.130 (ND)

TABLE B-1

Summary of Total PCB Results Used in Feasibily Study

Waukegan Harbor RI

Location	Sample ID	X Coordinate [1]	Y Coordinate [1]	Top of Sediment Elevation (lwd IGLD85)	Sample Mid-point Depth (ft)	Sample Mid-point Elevation [2] (IGLD85)	Total PCB (ppm) [3]
WH-SD052	WH-SD052-132_144	1125359.800	2074420.400	-14.810	-11.50	-26.31	0.127 (ND)
WH-SD052	WH-SD052-144_161	1125359.800	2074420.400	-14.810	-12.70	-27.51	0.127 (ND)
WH-SD052	WH-SD052-161_173	1125359.800	2074420.400	-14.810	-15.35	-30.16	0.111 (ND)
WH-SD053	WH-SD053-00_12	1125494.000	2074639.800	-21.367	-0.50	-21.87	0.145
WH-SD053	WH-SD053-12_24	1125494.000	2074639.800	-21.367	-1.50	-22.87	0.141
WH-SD053	WH-SD053-24_36	1125494.000	2074639.800	-21.367	-2.50	-23.87	0.150
WH-SD053	WH-SD053-36_48	1125494.000	2074639.800	-21.367	-3.50	-24.87	0.154
WH-SD053	WH-SD053-48_60	1125494.000	2074639.800	-21.367	-4.50	-25.87	0.167
WH-SD053	WH-SD053-60_69	1125494.000	2074639.800	-21.367	-5.60	-26.97	0.124 (ND)
WH-SD053	WH-SD053-69_81	1125494.000	2074639.800	-21.367	-7.20	-28.57	0.112 (ND)
WH-SD059	WH-SD059-00_12	1124749.500	2074662.700	-17.402	-0.50	-17.90	0.178
WH-SD059	WH-SD059-12_24	1124749.500	2074662.700	-17.402	-1.50	-18.90	0.165
WH-SD059	WH-SD059-24_36	1124749.500	2074662.700	-17.402	-2.50	-19.90	0.236
WH-SD059	WH-SD059-36_48	1124749.500	2074662.700	-17.402	-3.50	-20.90	0.248
WH-SD059	WH-SD059-48_60	1124749.500	2074662.700	-17.402	-4.50	-21.90	0.236
WH-SD059	WH-SD059-60_72	1124749.500	2074662.700	-17.402	-5.50	-22.90	0.336
WH-SD059	WH-SD059-72_84	1124749.500	2074662.700	-17.402	-6.50	-23.90	0.591
WH-SD059	WH-SD059-84_96	1124749.500	2074662.700	-17.402	-7.50	-24.90	1.513
WH-SD059	WH-SD059-96_108	1124749.500	2074662.700	-17.402	-8.25	-25.65	0.414
WH-SD059	WH-SD059-108_120	1124749.500	2074662.700	-17.402	-9.00	-26.40	0.111 (ND)

Notes:

[1] X and Y coordinates are recorded in Illinois State Plane Illinois East, NADD 83 coordinate system.

[2] Elevations are reported in International Great Lakes Datum, 1985 (IGLD 1985) of 577.5 feet above mean sea level.

[3] Total PCBs equal the sum of detections and half the reporting limit of non-detects for Aroclors 1221, 1242, 1248, 1254, and 1260. Samples containing non-detects for all aroclors are reported with a value representing the sum of half the reporting limit of each aroclor and noted with an ND (non-detect).

Abbreviations:

(ND) = non-detect

ppm = parts per million

ft = feet

IGLD85 = International Great Lakes Datum, 1985